Vol. 16, No. 7 July, 1960

LUBRICATION ENGINEERING

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

see page 308 for . . .

Spur Gears - Hertzian Contact Times

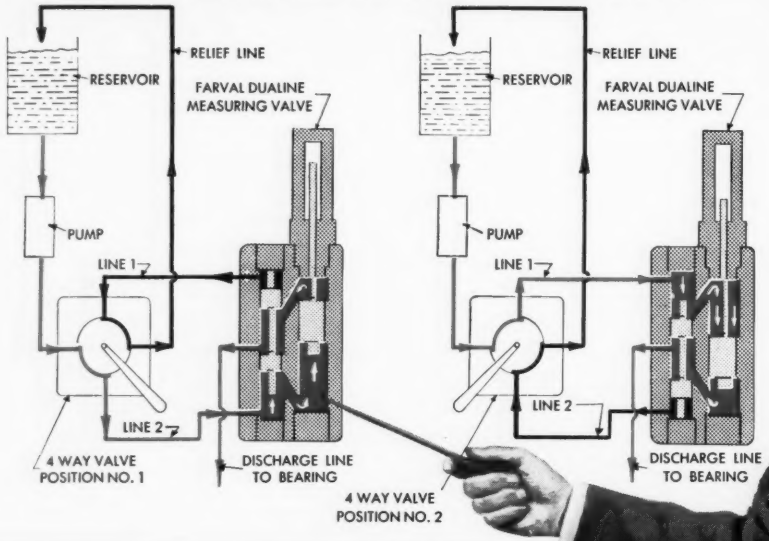
JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

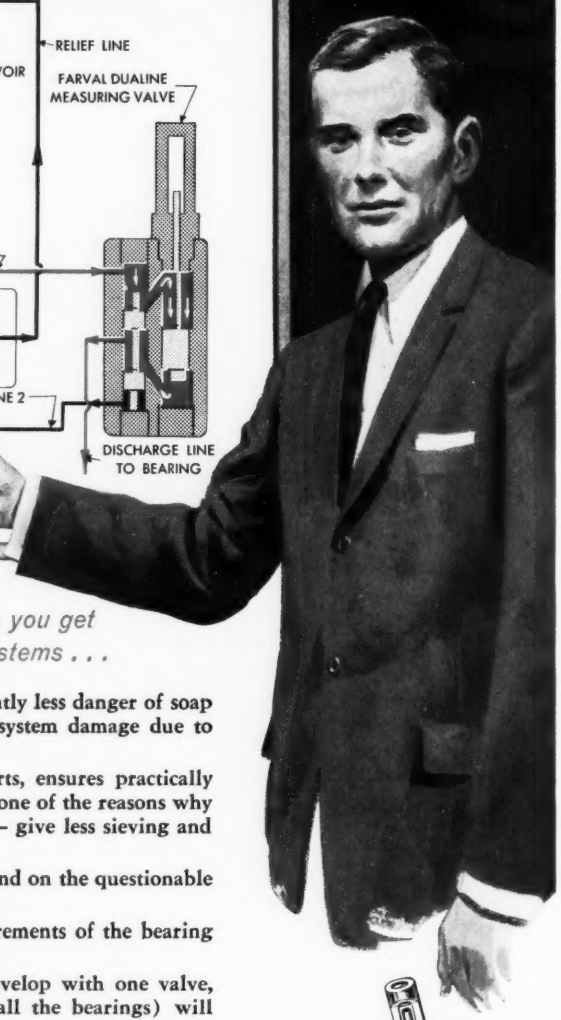
FARVAL
—Studies in Centralized Lubrication

No. 246

"For positive lubrication of large, medium and heavy-duty installations . . . it's a Farval Dualine System!"

FARVAL DUALINE SYSTEMS USE SIMPLE HYDRAULIC PRINCIPLES





With Farval Dualine centralized lubricating systems you get the following distinct advantages over other type systems . . .

(a) Much lower operating pressures with consequently less danger of soap separation on grease systems. Also, less danger of system damage due to high lubricant pressures.

(b) Large lubricant passages with no pinhole ports, ensures practically full pump pressure for every metering valve. This is one of the reasons why Farval Dualine systems operate on lower pressures — give less sieving and working of lubricants.

(c) Positive indication at each bearing — does not have to depend on the questionable action of a single indicator at the pump.

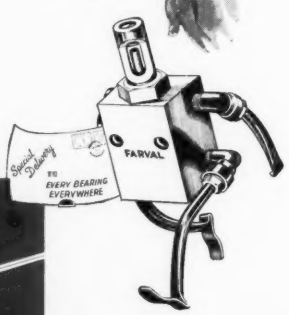
(d) Each metering valve individually adjustable for the requirements of the bearing it serves.

(e) Independent metering valve operation. Should trouble develop with one valve, the system will continue to operate. Only one bearing (not all the bearings) will require hand lubrication until trouble is corrected.

(f) True lubricant metering. Quantity of lubricant delivered to one bearing is not dependent on any other valve in the system.

(g) Much easier to spot and correct trouble.

Check with your Farval Representative and see how these versatile systems can improve production operations — reduce costs. Or write for free Bulletin 26-T containing complete engineering information on Farval Dualine systems.



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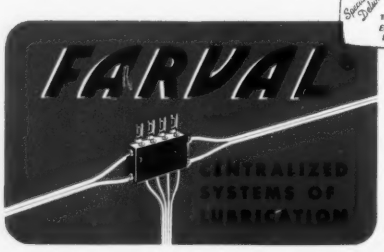
Eaton Manufacturing Company
3267 East 80th Street • Cleveland 4, Ohio



Volume 16, No. 7
July, 1960

Lubrication Engineering

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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"Ethyl" Antioxidant 703 has a unique and interesting chemical structure. It offers you a combination of properties that makes it the ideal antioxidant for synthetic jet engine oils, lubricating greases and other industrial lubricants.

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LUBRICATION IN THE NEWS

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FIRE-RESISTANT HYDRAULIC FLUID ACTS AS "INSURANCE POLICY" IN LARGEST SUPERSONIC WIND TUNNEL

A phosphate ester type of synthetic hydraulic fluid will actuate the hydraulic mechanisms of the largest supersonic wind tunnel in the western world, near completion at the USAF's Arnold Engineering Development Center, Tullahoma, Tenn.

Houghto-Safe 1120, a fire-resistant fluid supplied by E. F. Houghton & Co. will be the hydraulic medium to actuate 116 ball screw jacks. These flex the steel walls of the nozzle section of the tunnel, approximately 100 feet long and 1-½ to 3" thick, to the contours desired for testing aircraft, missiles, and their propulsion systems under simulated flight conditions. These walls will be positioned to various contours simulating mach number conditions within an overall systems accuracy of 0.035".

The need for a fire-resistant hydraulic medium was amplified by unusual design features of the tunnel. During operation, altitudes in excess of 24 miles will be simulated. Wind velocities approaching mach 5 are anticipated. Temperatures on the inside of the tunnel will reach 650°F., and in the area where the hydraulic motors and servo valves are installed, 550°F. temperatures will be commonplace. Water tracer lines will be used on all hydraulic lines to maintain hydraulic fluid temperatures at a reasonable level.

The series of ball screw jacks which will be actuated by the synthetic hydraulic medium will move on the basis of "orders" from a computer which forms the braincenter of the whole nozzle control system.

The heart of the tunnel's hydraulic system is the pump house which contains six 150-hp electric motors which drive twelve 35-gpm pumps (3,000 psi). Each of the 116 fluid motors and servo valves operates one of the jacks which position the walls of the tunnel nozzle within a tolerance of 0.035".

This unique hydraulic system was designed by Electric Boat Division of General Dynamics Corp. for the U. S. Army Corps of Engineers, which is the Government construction agency for the entire wind tunnel facility. (Source: E. F. Houghton and Co.)

THERMAL CONDUCTIVITY, MICELLAR STRUCTURE OF LUBE OILS STUDIED BY AIR FORCE, NAVY

Thermal conductivity of lubricating oils and the significance of micellar structure of certain oil-soluble soaps used as detergent additives to lubricants are described in two research reports released to science and industry through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington, D. C. The reports are:

Thermal Conductivity of Lubricating Oils and Hydraulic Fluids, D. W. McCready, University of Michigan, for Wright Air Development Center, U. S. Air Force. July 1959. 32 pages. (Order PB 161040 from OTS, U. S. Department of Commerce, Washington 25, D. C., $1). This study reports individual thermal conductivity values for 12 natural and synthetic base lubricant fluids. Each fluid had such different characteristics that correlation of their conductivity values proved impossible. The cell employed to measure thermal conductivity was of all-metal, concentric cylinder type. Its design components and assembly are pictured and described in detail.

Micellar Properties of Oil-Soluble Soaps and Their Significance in Detergency, W. D. Bascom, S. Kaufman and C. R. Singleterry, U. S. Naval Research Laboratory. Jan. 1960. 19 pages. (Order PB 161067 from OTS, U. S. Department of Commerce, Washington 25, D. C., 50 cents.) This interim study of oil-soluble metal soaps emphasizes the ability of micelles to solubilize otherwise insoluble polar molecules. It summarizes the micellar characteristics of oil-soluble soaps and the ways in which they affect rust inhibition and detergency in additives to petroleum lubricants. The Navy is continuing this research project. (Source: U. S. Department of Commerce)

GREASE PACKAGING AIDS LUBRICANT MARKETING

A fresh approach to grease packaging and dispensing has made itself felt in the national lubricants marketing picture during the past several years.

Along with a new grease cartridge, a dispensing gun has been developed and is marketed under the name, "ECONO CARTRI-LOADER".

For further information on this product packaging program contact: Battenfeld Grease and Oil Corp., Inc., 3148 Roanoke Road, Kansas City, Mo. ATTN: Lubricants Division. (Source: Battenfeld Grease and Oil Corp., Inc.

A NEW RUST INHIBITOR REPORTED

The development of a fully fire resistant rust inhibitor is described in a report of Armed Forces research released to science and industry through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce. The primary objective was to develop an all-purpose fireproof rust preventive to replace petroleum-base solvent types. An emulsifiable rust preventive (ERP) was selected for testing. Specifications for the ERP called for: maximum pour point of 32°F, moisture content under eight percent, no separation from 0 to 82°F, no gelling between 72 and 82°F, and more than a year's shelf-life from 50-110°F. Also the preventive had to be anticorrosive, protecting metals against continuous moisture condensation up to 120°F, protecting oil and grease up to 180°F, plus protection against a 20 percent salt spray up to 95°F. In addition, the preventive was required to be free of disagreeable odor and removable with naphtha and methanol cleaners. According to the report, the test product met these specifications. The report, *Emulsifiable and Fire Resistant Rust Preventatives*, may be had by ordering PB 161352 from OTS, U. S. Department of Commerce, Washington 25, D. C., price $2.00. (Source: U. S. Department of Commerce)

IRON AND STEEL ENGINEERS HOLD EXPOSITION

The Association of Iron and Steel Engineers Exposition and Convention will be held at Cleveland Auditorium, September 27 through September 30. An attendance of 15,000 steel plant supervisory personnel is anticipated. They'll review the latest products and services of nearly 200 steel industry suppliers, who will exhibit. Forty-two technical pages will be presented concurrently with the Exposition. (Source: Association of Iron and Steel Engineers)

(Continued on page 296)

LUBE IN THE NEWS

(*Continued from page 295*)

ADM TO BUILD CHEMICAL CENTER AT PEORIA

Archer-Daniels-Midland Company has announced that it will build a multi-million dollar chemical center near Peoria. John H. Daniels, president of the world-wide concern, said the new installation will mark a significant expansion by ADM in the chemical field.

ADM has purchased from the Toledo, Peoria and Western Railroad a 200-acre site six miles south of Peoria on the Illinois River. It has been reported that ground will be broken for the new Chemical Center in late summer or early fall, with plant operations scheduled to begin in the spring of 1962. The new facility will be a grouping of several chemical processing facilities. When in full production it will employ about 200 workers.

Explaining that the Peoria chemical center will provide a basis for future expansion in chemicals, Daniels said that when it is completed ADM will have facilities for increased production of nitrogen chemicals, plasticizers, esters, olefins, and many other chemical intermediates.

"Additional products developed in ADM's laboratories and now under test and market evaluation are approaching commercial production," he continued. "These also will be manufactured at the new Peoria Chemical Center."

Reportedly, the Peoria installation will be one of the most modern of its kind in the country and the most versatile plant in ADM's chemical group, Daniels said. Including the most advanced processing techniques for hydrogenation, molecular distillation, continous splitting, epozidation and ammonolysis, it will be adaptable to production of future chemicals developed through ADM's intensified research activities.

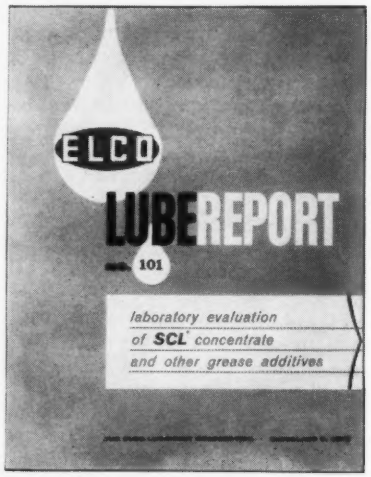
Peoria was selected as the site for the Chemical Center because of its strategic location in relation to ADM's chemical customers. Its rail, highway and river transportation facilities will enable ADM to supply these customers efficiently and economically. It also is well located with respect to sources of the plant's principal raw materials—soybeans, tallow and petrochemicals.

ADM, producer of chemicals derived from vegetables, animal, and marine fats and oils for 30 years, presently operates chemical plants in Minneapolis, Minnesota; Los Angeles, California; Newark and Elizabeth, New Jersey; Pensacola, Florida; Valley Park, Missouri; Ashtabula, Ohio; Wyandotte, Michigan, and Decatur, Illinois (Source: Archer-Daniels-Midland Co.)

NEW ELCO TECHNICAL REPORT PRESENTS TEST DATA ON GREASE ADDITIVES

Laboratory Evaluation of SCL and Other Grease Additives, is the title of a new technical bulletin published by The Elco Lubricant Corporation.

This 12-page report presents the results of laboratory tests conducted to evaluate SCL Concentrate as a grease additive. Data show a comparison of SCL, sulfur saponifiable-lead napththenate and MIL-L-002195A additives. All three additives were tested in seven major types of greases in 6, 8 and 10% concentrations. The blended greases were subjected to the requisite ASTM tests for greases.



All data is reported in complete detail and includes photographs showing moisture corrosion test comparisons.

This report will be of interest to all those responsible for the formulation, manufacture or use of greases.

Copies of Lube/Report No. 101 are available from The Elco Lubricant Corporation, Jennings Road Deniso Avenue, Cleveland 9, Ohio. (Source: The Elco Lubricant Corp.)

TTP TO EXPAND PLANT TO MEET GROWTH MARKETS

Tube Turns Plastics Inc. has announced the expansion of its Louisville plant to increase manufacturing, raw material and warehouse space by approximately one third.

Key unit in the company's expansion plans will be the erection of a new one-story steel and masonry building. The new building, adjacent to the existing plant, will provide an additional 6400 square feet of floor space, and is scheduled for occupancy this summer. (Source: Tube Turns Plastics, Inc.)

HIGH VACUUM FRICTION STUDIED BY AIR FORCE

A research study of surface friction under high vacuum conditions, conducted for the Air Force, has been released to science and industry through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce. The publication is: *Research Program on High Vacuum Friction: Final Report*. Litton Industries of California for Air Research and Development Command, U. S. Air Force. March 1959. 160 pages. A two-part study of surface friction under high vacuum conditions (10^{-5} to 10^{-6} mm Hg.) was conducted. The first part of the study describes preparations necessary to conduct experiments. The second part explains the methodical examination of the friction characteristics of a large group of materials. Linear motion between two dry, clean, unlubricated, flat surfaces comprised the principal test condition. The microscopic nature of the actual surface-to-surface contacts was studied and results showed that under certain conditions models, loaded to yield pressures, could be made to slide with abnormally low friction forces without microscopic evidence of wear or surface distortion. This report is available by ordering PB 161116 from Publications and Public Information Division, OTS, U. S. Department of Commerce, Washington 25, D. C., price $3.00. (Source: U. S. Department of Commerce).

COST REDUCTION ACTIVITIES APPOINTED WESTERN REPRESENTATIVE FOR LENGOR, INC.

Lengor, Inc., manufacturer of the patented Simplex Portable Oil Testing Kit, has appointed Cost Reduction Activities, Sacramento, California, as sales representatives in California, Oregon, Idaho, Nevada, Arizona and Utah.

Headed by Mr. John C. Freeman, Cost Reduction Activities counsels business firms in procedures, techniques, and practices designed to reduce the maintenance costs of fleet vehicles.

The Simplex Portable Oil Testing Kit was developed and produced by Lengor, Inc., as a preventive maintenance tool employed by Cost Reduction Activities. The kit permits on-the-spot laboratory-type analysis of engine oils.

The kit, meeting Federal and professional performance standards, reportedly reveals the presence of dangerous contaminants in engine oil. It exposes abrasive solids, fuel dilution and corrosive acids and allows oil and filter changes based on analysis. (Source: Lengor, Inc.)

INDUSTRY NOTES

In its recent move to Collingwood Park, N. J. from its former plant in Madison, N. J., the Bel-Ray Company has tripled its former facilities and gained a tank farm for the storage of over a score of components as well as 1500 feet of railroad siding. On the farm, metered tanks form a battery of gigantic beakers from which accurately measured amounts of the contents of any one tank can be automatically siphoned into a slurring tank for blending with the similarly measured contents from any of the other tanks to formulate a specified lubricant.

According to William C. Kiefer, president of Bel-Ray, the company's process of manufacturing lubricants is designed to service industries in which the nature of the product or the production machinery sets up unusual requirements for the lubricants used. He cites the non-toxic, colorless "No Tox" lubricant supplied the food industry as an example of the former and the non-galling molylube "Anti-Seize" (extreme pressure lube) supplied to the mold and die shops as an example of the latter.

Completion of a new quality control laboratory is announced by The Kaydon Engineering Corp., providing the firm with precision gage setting and measuring facilities said to be among the best in the nation.

To permit highly accurate measuring of the large sized bearings up to 15 feet in diameter offered by Kaydon, all environmental conditions must be controlled in the gage room, including temperature, humidity, air currents, and dust.

The new laboratory is reported to provide conditions for measuring bearing parts to an accuracy of five millionths of an inch. (.000005"). This compares with dividing a human hair into 600 parts and gaging accurately to within the measurement of one of these parts.

Kaydon's large size bearings present many unusual gaging problems not found in the measuring of smaller bearings. Since the diameter tolerance specified for such large bearings is usually two thousandths of an inch (.002"), each individual part must be held to an extremely close tolerance to provide the proper precision in the completed bearing.

In measuring the diameter of a bearing, each degree difference in temperature between the gage and the bearing induces an error of seven millionths of an inch. (.000007") per inch of bearing diameter. For example, on a 160 inch diameter bearing the error would total more than one thousandth of an inch (.001") or half of the allowable tolerance for this size of bearing.

Measuring 25 x 52 feet, the two-room laboratory is centrally located inside the Kaydon plant but has its own floor, walls, ceiling and an air lock entry. A plastic enclosure or "envelope" of polyethylene surrounds the laboratory to keep out vapor and dust.

Particles, up to 0.3 microns (.000012") in size, which are smaller than cigarette smoke, are filtered out by a three-stage filter system. The filters include a conventional spun glass throw away type, an intermediate standard paper type with 85% efficiency, and a final special paper type with 99.67% efficiency. An automatic gage indicates when filters should be changed.

As a second source of Permawick self-wicking lubricant for equipment manufacturers, Wesco Manufacturing Co., of Two Rivers, Wisconsin, has been appointed as a manufacturer-liscensee, announces David Tann, president of the Permawick Company, Detroit. Wesco, a major manufacturer of wool and yarn packings for fractional horsepower electric motors, was a logicagl choice to produce Permawick which is now used by 90 per cent of FHP motor makers.

Permawick is a combination of turbine-grade oil and special fibers which have the ability to absorb and release the oil as it is needed for lubrication, and reportedly enables designers to eliminate oil filler holes and reduce bearing cavity sizes while providing the same amount of lubrication in properly metered amounts.

PERSONALS

The transfer of Howard O. Leslie from Moline to its Chicago sales office as a district sales engineer has been announced by Chain Belt Company, Milwaukee.

The promotion of Donald W. Lange to sales engineer in the Chicago office and the appointment of Frank W. Cowdrey as sales engineer in the Southern California sales office of Parker-Hannifin Corporation, have been announced. Both Mr. Cowdrey and Mr. Lange will represent Parker-Hannifin industrial pneumatic and hydraulic products including power cylinders, valves, accumulators, tube and hose fittings, presses and riveting machines.

Cleveland Worm and Gear and Farval Divisions of Eaton Manufacturing Company have announced the appointment of new engineering sales representatives in Cleveland, Pittsburgh and Philadelphia to replace The Dingle-Clark Company which recently announced its retirement from the agency business. The three agencies which now represent the two Eaton divisions are being operated by former executives of Dingle-Clark in those cities.

In Cleveland, the R. V. Robison Company—**R. V. Robison** will be assisted by **J. E. Peters** and **E. J. Gruber.** in Pittsburgh, the J. P. Murray Co.—**J. P. Murray,** whose associates are **G. L. Engelbret, L. B. Abrams** and **T. F. Hatch.** In Philadelphia, W. M. Stilwell formed a sales agency under his name. Associated with Mr. Stilwell are **T. B. Ryan** and **S. G. Lugar.**

Ernest E. McClung has been elected vice president and consulting chemist of the Van Straaten Chemical Company, Chicago. McClung, a registered professional engineer in the State of Illinois, holds both a BS in CH.E. and the professional degree of CH.E. from the Armour Institute of Technology, joined the Van Straaten firm 19 years ago in the Chemistry department.

ERNEST E. McCLUNG

The Briggs Filtration Company announces the appointment of Walter E. Yedlinsky as representative for industrial sales in the western Pennsylvania area.

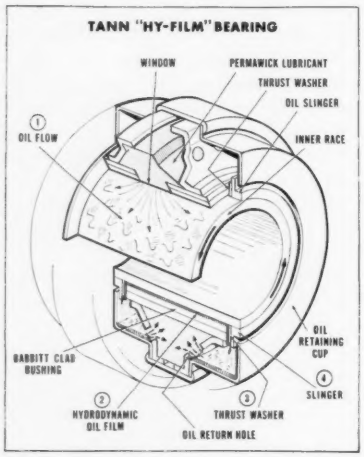
Lawrence C. Anderson has been appointed Chicago district field representative for Cleveland's Air-Maze Corporation, leading producers of air and fuel filters. Anderson's new sales territory will include Illinois, Indiana, Missouri and other midwestern states.

(Continued on page 332)

NEW PRODUCTS

NEW TYPE OF BEARING OFFERS HYDRODYNAMIC OIL FILM, 200,000 HOUR LIFE

The family of bearings of the Tann Corp., called the "Hy-Film" bearing, is a new line of packaged, off-the-shelf bearings, interchangeable with ball bearings in bore and shaft requirements.



Combining the design advantages of sleeve and ball bearings, the Tann Corp. claims the features of the new bearing to include a base life of 20,000 hours, a lifetime recirculatory oiling system, and a hydrodynamic oil film between inner race and bushing which supports the weight of the shaft, with no metal-to-metal contact at any point.

The "Hy-Film" bearing is said to be virtually vibration-free, noise-free, and resistant to humid and gritty atmospheres, and does not leak oil. Recommended operating temperatures range from —25° to 200°F.

Charts showing the curve of life expectancy at various loads and speeds for each size of the new bearing are available from the manufacturer. Using this data, claims Tann Corporation, designers may effect substantial savings by matching bearing sizes to their exact operating requirements.

The new bearing line is scheduled for volume production by September, 1960. Bores from eight to 40 millimeters will be stocked. Limited quantities are now available for research and development. For more information, contact: Tann Bearing Co., Division Tann Corp., 3750 E. Outer Drive, Detroit 34, Michigan.

ALL-PURPOSE RUST INHIBITOR COMPOUND INTRODUCED

The new preparation of a special combination of active materials dispersed in an oil carrier base, called POLY-RUSTEX, has been developed and is now being marketed by Brad Chemical, Inc., Chicago. It is claimed that with a single, low-cost application, the new rust inhibitor compound gives long-lasting corrosion protection to new metals, fabricated parts, machinery and tools, and all other forms of iron and steel.

POLY-RUSTEX reportedly will not discolor the meal, yet provides protection that will not wash or wear away under normal conditions.

For complete information on new POLY-RUSTEX Rust Inhibitor, write to Brad Chemical, Inc., 111 West Washington Street, Chicago 2, Illinois.

NEW ELASTOMER FOR FLUOROCARBON FLUID SEALS ANNOUNCED

Fargo Rubber Corporation of Los Angeles, California, has developed an elastomeric compound with capabilities for seals, O-rings, and packings for precision instruments and systems containing fluorocarbon fluids and lubricants, and helium gas.

It has been reported that accelerated service tests involving simultaneous interexposure of the new compound, FR 6-60-13, fluoroester alcohol, fluorocarbon oils, and copper resulted in no discoloration of the fluid, and no corrosion of the metal. Volume change was +14%, weight change of the elastomer was +18%. The tests indicated that service integrity greater than five years can be expected from these seals.

The manufacturer claims that O-rings manufactured from this elastomer are particularly suitable for seals in inertial guidance equipment. In order to cope with the stringent requirements of inertial instrument, O-rings manufactured from this material are molded in chrome-plated tooling to prevent acquisition of contaminants; final trim and inspection is performed under ten-power stereomicroscopes.

Test reports and technical information on FR 6-60-13 is available from Department PC, Fargo Rubber Corporation, 137 East 58th Street, Los Angeles 11, California.

NEW HI-TEMP RING SEAL INTRODUCED

Just introduced by the Gits Sealing Device Division is a non-split, hydraulic and pneumatic linear-motion ring seal. Its special, all-metal construction permits use at temperatures from —425° to 1500°F.

Called the Hi-Temp Ring Seal, this product was developed to satisfy the demand for high-temperature seals in hydraulic actuators, for high-temperature static seal applications and for high-temperature swivel joint seals.

Designed as a unit, Seal comprises a metal lip of special design and configuration, fastened in a stainless steel ring. The ring is designed to support the lip in axial direction and to prevent blow-out under extreme pressures.

The seals are reported to have been tested under hydraulic pressures in excess of 20,000 PSI, without showing leakage or other ill effects and are compatible with practically all hydraulic fluids and gaseous media.

For further information, write Gits Brothers Mfg. Co., 1866 S. Kilbourn Ave., Chicago 23, Ill.

TEST BENCH AVAILABLE TO CHECK QUALITY OF HYDRAULIC FLUIDS

A hydraulic fluid test bench weighing approximately 2750 pounds has been designed and manufactured by Schroeder Brothers Corp., specialists in hydraulic testing and maintenance equipment.

The manufacturer reports that the Schroeder Test Bench is used to determine the lubricating qualities of the fluid under test and can be adapted for use with each of the four recognized types of fire-resistant fluids—inverted or water-in oil emulsions; regular or oil-in-water emulsions; glycal base and phosphate esters.

For detailed information: write Schroeder Brothers Corp., Nichol Ave., McKees Rocks, Pa.

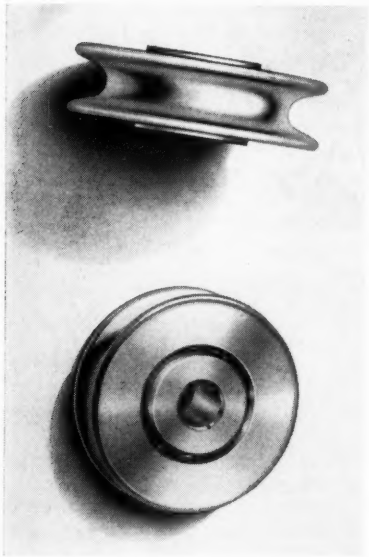
(*Continued on page 299*)

NEW PRODUCTS

(*Continued from page 298*)

NEW BALL BEARING PULLEYS AVAILABLE

A new series of low cost ball bearing pulleys, for use with rope, wire rope or cable, is now available from Syracuse Bearing Company, Syracuse, N. Y. The bearing rings of these units are made of case hardened steel to provide high load



capacity and cable groove wear resistance. Precision steel balls, operating in unground raceways, provide free turning. The low bearing friction and tapered and rounded grooves are designed to ensure minimum cable slippage and groove wear.

For catalog listing of stock sizes write: Syracuse Bearing Co., 428 E. Jefferson St., Syracuse, N. Y.

NEW HIGH-TEMPERATURE LUBRICANT ANNOUNCED

A new high-temperature lubricant claimed to have excellent thermal and oxidation-corrosion stability has been developed by Metal and Thermit Corp. Called Dipenylbis-*n*-Dodecylsilane, it is a colorless, mobile liquid. Suggested applications by the manufacturer include base stock for high temperature aircraft gas turbine lubricating oil, where thermal stability in 500-700° F range; as an extremely stable high-temperature heat transfer fluid; and as the base stock for lubricating oils and greases where high temperature stability and low vapor pressure are required.

For further information, write Commercial Development Division, Metal and Thermit Corp., 100 Park Ave., New York 17, New York.

ANDEROL SYNTHETIC OIL AVAILABLE FOR EXTREME LOW TEMPERATURE INDUSTRIAL APPLICATIONS

A synthetic oil, designed for extreme low temperature applications such as chart drives, clock movements, meteorological and aircraft instruments is being marketed by the Lehigh Chemical Company, Chestertown, Maryland.

Called Anderol L-423, this light viscosity diester oil features a pour point of below 105°F and a viscosity at 90°F of only 5,000 C's and is designed to meet the requirements of low starting and running torques over a temperature range of −100°F to 250°F.

For specific problems, Lehigh representatives will make recommendations and help find practical and economical solutions. Write Lehigh Chemical Company, Chestertown, Maryland for information and samples.

LUBRICANT IN NEW SPRAY-ON CONTAINER

The Whitmore Manufacturing Company announces the availability of its new Open Chain Lubricant, packaged in a 16-oz. push-button aerosol container for fast and easy application to conveyor, elevating, and transmission chains of all types.

The manufacturer states that the lubricant was formulated especially for use on open chains and combines the features of a penetrant, a lubricant, and a rust-preventive which is claimed to lengthen open chain life up to 300%. The lubricant was developed to work into close-tolerance, internal friction surfaces of open chains—between bushings and pins and bushings and rollers—to reduce wear and dissipate heat. It features a built-in corrosion inhibitor that is claimed to end rust and corrosion of costly open chains.

A free trial 16-oz. can of Whitmore's Open Chain Lubricant is available from The Whitmore Manufacturing Co., Cleveland 4, Ohio.

LARGE HP ADJUSTABLE SPEED DRIVES ADDED TO PRODUCT LINE

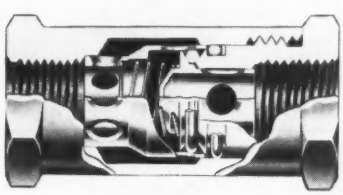
Magnetic Drives, in ratings from 75 to 4000 HP, have recently been added to the adjustable speed drive line of the Louis Allis Co., Milwaukee. The drives are said to feature simplified design with few moving parts and provide versatile adjustable speed performance over an automatically regulated 20:1 range.

The manufacturer states that drive is based on a liquid cooled magnetic coupling design that features stationary field construction, bearings that can be relubricated without disassembly, and a unique cooling system. The cooling system design permits a planned flow of air through the drive at all times and eliminates any possibility of bearing condensation and drive flooding. Since coolant does not contact the adjustable speed member, "water drag" is eliminated and closer, more uniform speed regulation is obtained throughout its range.

Magnetic Drives operate from AC power and are offered as a complete drive package including drive unit with water controls, controller enclosure and operator's station. For complete details, write for Bulletin #3650, The Louis Allis Co., Dept. P, 427 E. Stewart St., Milwaukee 1, Wisconsin.

NEW CIRCLE SEAL CHECK VALVES DEVELOPED

A new Circle Seal 200 Series engineering development is offered to assure O-ring reliability against high pressure split-second surge flows. Fool-proof O-ring retention is said to be assured by an ingenious cage device which restrains the O-ring from washout.



Dead tight sealing and chatter-free operation is reportedly derived from the Circle Seal design, providing proper cushioning combined with low pressure drop and dependable, sensitive, lead-free reseating. These features make the 200 Series valve suitable for use in a wide variety of high pressure gas or liquid services where extreme surge flows are encountered. Bodies of brass, aluminum, steel and stainless steel are available and range in size from ⅛ to 2 inch pipe size. For more information, write Circle Seal Products Co., Inc., 2181 East Foothill Blvd., Pasadena, Calif.

(*Continued on page 300*)

DO YOU...

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LUBRICATION ENGINEERING

without charge?

Send us their names. We will mail them a copy—with your compliments.

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Sender's Name

Street Address

City and State

460

NEW PRODUCTS

(Continued from page 299)

NEW OIL TEST KIT AVAILABLE

A new oil test kit called "AKRA-EZ" has been developed by the R & W Engineering Company of Anaheim, California. The new kit is designed to simplify the oil testing methods to provide a time saving and accurate analysis of oil; a complete oil analysis including neutralization number (acidity), viscosity, water content, insoluable contaminents, metal contaminents and temperatures.

Components of the kit include: (1) a lightweight carrying case; 2) the unique use of magnets for determining viscosity; 3) a simple hand sling type centrifuge; 4) a magnetic detection device for metallic contaminents within the oil; 5) a simplified titration test for oil acidity; and 6) a comprehensive manual which illustrates and explains all procedures and other pertinent information regarding lubricating and power oils.

The AKRA-EZ has been in design and test for over two years. According to the manufacturer, considerable savings can be enjoyed by the use of the kit. A complete oil analysis can be made in twelve minutes. Individual tests for viscosity, acidity, etc. can be made in a matter of a very few minutes. The use of the kit requires no technical training as all procedures are simply outlined step by step, complete with photographs, in the AKRA-EZ Manual. Also, included in the manual is information concerning recommendations for lubricant changes, minimum and maximum temperatures, reasons explaining the importance of an oil test program, why oil breaks down, and how to get maximum life from the oil. Special charts are included which provide an easy method of plotting viscosity and neutralization number. The manufacturer claims the proper plot of test results is just as important as the test.

For further information contact: R & W Engineering Company, 2118 West Cris Ave., Anaheim, California.

FILAMENT-WOUND FIBRE-GLASS RINGS OFFERED

Apex Reinforced Plastics announced the development and manufacture of filament-wound fibre-glass rings, designed to provide internal support to fibre-glass tubes subjected to external pressure of 500 psi.

The rings, ¾" × ¾" × 20 OD, are wound from continuous filaments of fibreglass by passing the glass through a thermosetting resin onto a split mold for support and cure. Originally wound in tubular form, the rings are cut as segments across the section of the tube after the winding and curing process is complete.

Finished rings are turned to proper size to fit into a cylinder of dry glass, which is then centrifugally molded. The end product is a tube with equally-spaced ribs imbedded in the inner surface of the fibre-glass walls. Rings contain 75% glass by weight. It is reported that in this application, the rings provide 150,000 psi tensile strength.

Further information about filament-wound fibre-glass rings may be obtained by writing Apex Reinforced Plastics, Washington and Elm Streets, Cleveland, Ohio.

NEW CIRCLE CLAMP FOR HOSE REEL

"Croft" spring-hose reels, manufactured by William Turk Company, Lynwood, Calif. for use in service stations and industrial plants for oil, water, and air lines, automatically retract the hose when the user is through with it. A large ruber ball just below the hose nozzle or air fill valve, acts as a stop to prevent the hose from winding all the way back into the reel cover. The ball also protects the fitting from absorbing the shock of the retracting line.

A Circle clamp is used as an air-tight connection between the hose line and the valve or nozzle insert, and it also serves as a retainer to prevent the ball from being driven down over the insert. Fastened on the hose line, the one-piece metal U-shaped forward folds of the clamp keep the rubber ball from moving out of position. The clamp is tightened securely by simply squeezing these folds together with a simple hand tool.

The Circle clamps may be secured from the Circle Clamp Division of Cuyahoga Corp., Cleveland, Ohio.

PRODUCT LITERATURE

NEW CATALOG OF FORCE FEED LUBRICATORS

A new catalog illustrating and describing its full line of Force Feed Lubricators has been produced by Manzel, a unit of Houdaille Industries, Inc. A year and a half in production, this 44-page booklet is the most complete ever assembled. In it is basic information on the principles of force feed lubrication including valuable engineering data on the viscosities of various lubricants.

In addition to the specific, detailed operating instructions for each type of lubricator, the Manzel catalog illustrates many ways in which they can be adapted to specific equipment. An easy-to-read chart offers a quick comparison of all the lubricators with reference to pumping unit characteristics, priming methods, drive types and locations, and lubricants available.

Manzel, the originator in 1898 of force feed lubrication for steam engines, now supplies literally every industry. Manzel Force Feed Lubricators provide scientifically correct lubrication for cylinders, bearings, packings, V-ways, slideways and other moving parts.

Copies of the calalog may be obtained by writing Robert W. Meyers, Sales Manager, Manzel, 315 Babcock Street, Buffalo 10, New York.

NEW BOOKLET ON BEARING MOUNTINGS AVAILABLE

New concepts for applying thin-sectioned large bore ball bearings to equipment designs are presented in a 28-page engineering booklet now available from The Kaydon Engineering Corp., Muskegon, Michigan.

Installation drawings illustrate applications ranging from wire twisting machines to paper-making machine press rolls, and from heavy-duty lathes to submarine periscopes. Also pictured in the booklet are 23 drawings of commercial and space age designs including transmissions, machine tools, manufacturing and assembly machines, control equipment, instrument mounts, and clutches.

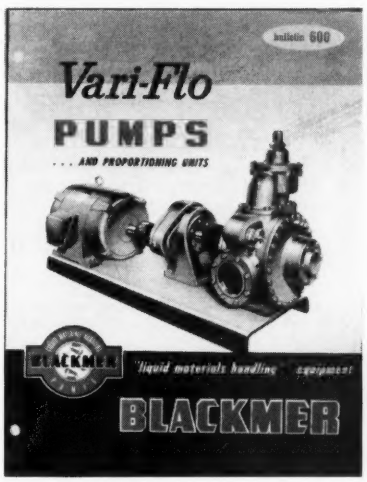
The booklet, Bulletin S-112R, includes specifications and prices for the new off-the-shelf ball radial type "CP" Reali-Slim bearings. *Selected Engineering Drawings for Mounting Reali-Slim Bearings* is available free to requests on company letterheads addressed Kaydon Engineering Corp., McCracken St., Muskegon, Michigan.

NEW BULLETIN DESCRIBES VARIABLE CAPACITY PUMP

Grand Rapids, Mich.—A new line of variable capacity rotary pumps is described in the eight-page Bulletin No. 600, just released by Blackmer Pump Company, Grand Rapids, Mich.

According to the bulletin, this new pump, called the Vari-Flow, now makes it possible to "dial" any desired flow rate, from zero to full capacity, without changing pump speed. Formerly this type of control required variable speed drives, but the new Vari-Flo achieves the same result using a standard fixed-speed motor.

Bulletin 600 explains in detail the unique principle of operation that gave rise to the Vari-Flo design. It includes cutaway illustrations of four basic models, which are offered in a choice of ball-bearing or packing-gland types, and in three sizes up to 450 gallons per minute.



The Bulletin also provides a complete guide to selection of Vari-Flo pumps, including a step-by-step outline of selection procedures, application data tables, and performance curves.

A final point covered in the literature is a basic discussion of simplified liquid proportioning, which the company claims is now possible with the use of special systems incorporating one or more Vari-Flo pumps.

Copies of Bulletin No. 600 and further information about the Vari-Flo pump are available from Blackmer Pump Company, Grand Rapids 9, Mich.

TECHNICAL BULLETIN ON HEAT-TRANSFER OIL OFFERED

A two-page technical bulletin on heat-transfer oil is now available from Sun Oil Company, giving complete information on Sun 21 heat-transfer oil, including properties and advantages.

Advantages claimed for the oil include: high thermal efficiency; high thermal stability; easy circulation; low pressure opperation; absence of offensive odors; and long service life.

Copies of the technical bulletin are available on request from Sun Oil Company, Industrial Products Dept., 1608 Walnut Street, Philadelphia 3, Pa.

AN INDUSTRIAL ANTIOXIDANT DISCUSSED IN BROCHURE

The applications of Tenamene 3(2,6-di-tert-butyl-p-cresol) as an industrial antioxidant are discussed in a new 16-page brochure available from Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company.

Performance charts and graphs illustrate the effectiveness of Tenamene 3 as an antioxidant for such materials as lubricating oils, turbine oil, paraffin wax, motor and aviation gasolines, rubber, paints, elastomers, polyethylene, and insecticides. Other miscellaneous industrial applications are described and complete data on the physical properties of Tenamene 3 are presented in tabular form.

Copies of the brochure (Bulletin #I-107) are available upon request to Eastman Chemical Products, Inc., Kingsport, Tennessee.

NEW BROCHURE ON AXIAL PISTON PUMP SERVICE AT 5000 PSI PUBLISHED

A new, eight-page brochure on the use of Denison axial piston pumps at pressures up to 5000 psi has been published by the Dension Engineering Division, American Brake Shoe Co.

The new publication discusses the company's 30, 40 and 60 Series pumps, in both constant and variable volume models. Performance and torque curves are illustrated, as well as complete schematics which illustrate the exial piston techniques of pumping. A ratings chart for both pumps and fluid motors, ranging in maximum pressures from 3500 psi to 5000 psi is included. Accessory valves and controls to be used in 5000 psi systems are also reviewed.

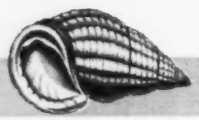
Copies of Bulletin 203 may be obtained from Denison Engineering Division, American Brake Shoe Company, 1160 Dublin Road, Columbus, Ohio.

Wherever in the world your industrial machinery operates...

Shell Alvania Grease is there

Other outstanding Shell Industrial Lubricants available world-wide

- **Shell Tellus Oils**—for hydraulic systems
- **Shell Talona R Oil 40**—anti-wear crankcase oil for diesel locomotives
- **Shell Rimula Oils**—for heavy-duty diesel engines
- **Shell Turbo Oils**—for utility, industrial and marine turbines
- **Shell Dromus Oils**—soluble cutting oils for high-production metalworking
- **Shell Macoma Oils**—for extreme pressure industrial gear lubrication
- **Shell Voluta Oils**—for high-speed quenching with maximum stability



AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Alvania** beanii.

Around the world, Shell Alvania Grease is available—under the same brand name and providing the same outstanding lubrication. This is assurance that your customers abroad will enjoy the same performance from your equipment that domestic customers rely upon.

Alvania® Grease offers these performance-proved advantages: (1) It provides safe lubrication at both high and low temperatures. (2) It won't wash out even in locations where water splashing can't be avoided. (3) It has built-in protection against rust and pitting of anti-friction bearings. And because this *one* multi-purpose grease is specially designed to satisfy as much as 90% of industrial grease needs, less servicing time is required; inventory costs are less; and there is less risk of misapplication.

No matter where your machinery is shipped, make Shell Alvania Grease your standard recommendation. Write for complete information.

SHELL OIL COMPANY

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100 BUSH STREET.....SAN FRANCISCO 6, CALIFORNIA
IN CANADA: SHELL OIL COMPANY OF CANADA, LIMITED
505 UNIVERSITY AVENUE.....TORONTO 2, ONTARIO

SOCIETY NEWS

The following is a summary of Committee reports and Board actions at the 15th Annual Meeting, Cincinnati, Ohio, April 19-21, 1960.

Executive Committee—Under the old By-Laws, this committee was empowered to act for the Board on all matters of detail excepting the election of officers and any matter involving changes in established Society policy. In a sense, the Executive Committee's primary function was to help the Board conduct Society affairs as efficiently and as smoothly as possible and its powers were so designed. The Rules Committee has been charged to review these powers so as to establish more accurate guide lines for the Executive Committee's area of activities under the new Constitution and the Rules Committee report will be discussed later in this summary.

Treasurer's Report—The auditor's report for the year 1959 is shown in detail on pages 330 and 331 in this issue. This report shows that the Society had a very satisfactory year financially.

Presidential Council—Since the adoption of the new ASLE Constitution, all former presidents are now members of the Presidential Council. This council is designed to act in an advisory capactiay to the Board on matters pertaining to the management or policy of the Society. At it's inaugural meeting, the council discussed the Society's growth and importance to industry. Several suggestions were presented, among others, was the ways and means by which the Society could call upon industry to support research projects as a part of ASLE's activities. The Board appointed the Presidential Council to serve as a committee for the purpose of increasing industrial membership and recommended that a program be developed and submitted to the President for action.

Advertising *(Lubrication Engineering)*—Gross advertising revenue from Lubrication Engineering in 1959 represented about 31% of the Society's income for that period. This compares favorably with the previous year. From all appearances, 1960 prospects are on much the same level as the past two years. Efforts are being directed to follow-up on the more "practical editorial approach" of Lubrication Engineering. A select list of prospective advertisers and their agencies has been compiled and a periodic promotional mailing is planned to keep these people abreast of editorial developments.

Handbook Advisory Committee—Excellent progress has been made in the past year toward the finalization of the Handbook. The Editor-in-Chief met with many of the Authors at the Annual Meeting and 1961 is the date set for completion.

Membership & Admissions Committee—A mail promotion campaign was undertaken during this year. It is too early, however, to predict the results of this campaign. Membership totals have taken a slight decrease since the peak which was reached in April 1958. A motion was made to establish an initiation fee of $10, which funds would be allocated to cover the cost of publishing an annual roster of society members. This motion was referred to the Publications Committee for study.

Annual Meeting—Total attendance at the annual meeting was 1039, which is greater than 1959. Twenty-two exhibitors took 26 booths and more than 300 attended the ASLE Annual Banquet. The 1961 Annual Meeting is scheduled for Philadelphia (Belleview Stratford Hotel); 1962, St. Louis, Missouri (Chase-Park Plaza); 1963, Chicago (Morrison Hotel); and the 1964 Annual Meeting is scheduled for New York City. The selection of a hotel is still to be made.

Lubrication Conference Committee—Plans are progressing satisfactorily for the forthcoming ASLE/ASME Lubrication Conference to be held in Boston, Massachusetts, October 17-19. The conference will maintain its high quality standards because of the large number of papers that are being offered.

Rules Committee—A report defining the actions of the Executive Committee under the new Constitution was submitted and approved by the Board. In essence, the Executive Committee is to act for the Board between their regular meetings in certain specific areas. The actions considered by the Executive Committee are those required before the next scheduled Board Meeting. At the discretion of any Board member the Executive Committee may function as a reviewing committee on Standing and *Ad Hoc* Committee reports. A contingency budget is to be established to pay for unanticipated expense items, however, when the unanticipated expense items exceed the contingency budget limitation, or a question of new policy is involved, the matter shall be submitted to the Board with a committee recommendation. The Executive Committee shall administer the salary budget.

Program Committee—The Board approved a new concept for review of papers which would permit technical review and format review at the same time. These duties will be assigned to the Editorial Review Committee and will be placed into effect immediately. This committee will be expanded to handle this assignment. Particularly in the first year of operation, it will be essential for the Session Organizing Chairmen to warn authors that deadline dates are realistic and they must be met.

Technical Committee—The technical coordinator is assembling from each committee chairman a summary of the intent and purposes of each committee, along with a complete roster of each. It was suggested that the committees utilize more fully the existing source of abstracts which are later published in *Lubrication Engineering*. The Bearings and Bearing Lubrication Committee reported that they have been obtaining from their members extraordinary translation and abstracting service. The Lubricant Reclamation and Disposal Committee is considering a change in name which will more clearly define their interests. The Lubrication Fundamentals Committee sponsored a seminar on solid film lubrication in conjunction with the annual meeting and found this to be very successful. It is planned to continue these seminars. Seals and Packings Committee reported that their Research Sub-Committee has been very active in compiling data as a result of inquiries to industry and from this data charts, tables and recommendations were written up. The Lubrication Equipment Committee reported that they plan to prepare and publish a guide of technical data that would be helpful to users of lubricating equipment. Mr. A. E. Baker, General Electric, and Mr. R. C. Garretson, Westinghouse, were elected by the Board for a three year term to the Joint Technical Committee Steering Body. Other members include: R. W. Blair (Chicago Rawhide), Coordinator; D. W. Sawyer (Alcoa), Vice-Chairman; Douglas Godfrey, (California Research), Secretary. Bearing Symposium—Originally scheduled for January 1961 as a special meeting, this symposium will now become a part of the 1961 Annual Meeting. This should make the overall program of more interest to those concerned with the design and lubrication of bearings in heavy industry. Standard Mathematical Symbols —ASLE's symbols have been submitted to ASA for adoption. Z-11 of ASA is taking the request under advisement at the June 1960 meeting in Atlantic City.

Industry Lubrication Councils—Five of the councils have agreed to sponsor a session each at the 1961 Annual Meeting and the Railroad Council is planning to sponsor two sessions, making a total of seven. All the councils met at the time of the Annual Meeting, except Aviation and Textile, and have organized their programs for the coming year. A complete list of the councils and their chairmen will appear in the August, 1960 issue of *Lubrication Engineering*.

(*Continued on page 305*)

Better Greases Through BAROID RESEARCH

BARAGEL* gives more efficient gel structure —in a greater variety of oils

BARAGEL, a non-soap grease-gelling agent, gives high gel structure in a great variety of oils. This versatility is the result of constant research in Baroid Chemicals' Houston Laboratories. BARAGEL greases are compounded and subjected to the most rigid testing.

One of these tests measures oxygen absorption to determine the resistance of BARAGEL greases to oxidation. BARAGEL greases are easily inhibited with a variety of antioxidants to provide excellent oxidation resistance. Such greases show minimum oxygen absorption under the most rigorous operating conditions.

BARAGEL is a reaction product of mixed organic ammonium halides and refined sodium montmorillonite. BARAGEL is a member of the BENTONE* family of products which has been outstandingly successful in lubricating greases, paints, plastics, inks and other fields.

* Trademark of National Lead Company for an organic ammonium montmorillonite

6063

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A SUBSIDIARY OF
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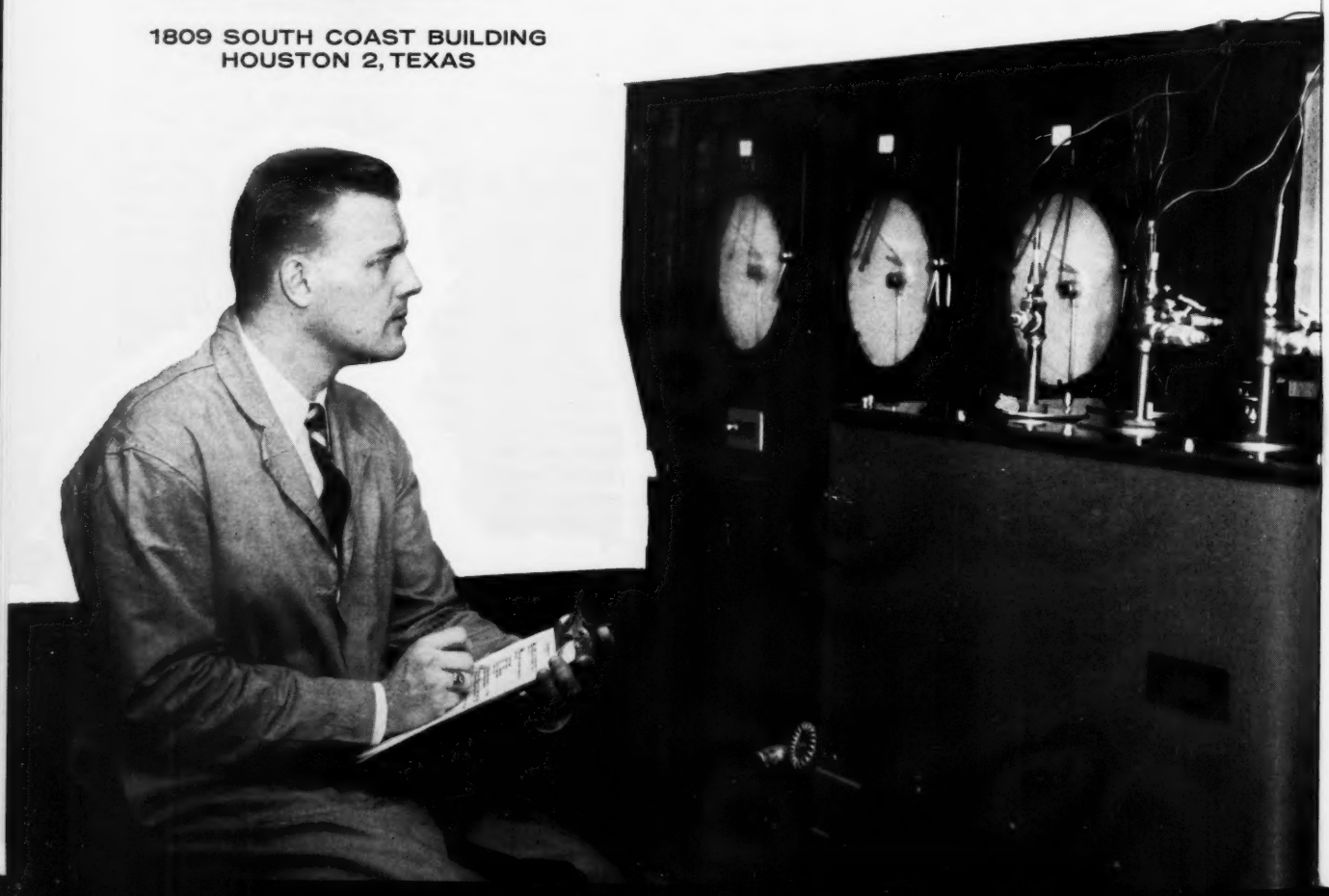

SOCIETY NEWS

(*Continued from page 303*)

NEW ASLE MEMBERS— MAY, 1960

CLEVELAND

DOUGLAS W. LEADER (R)
Cleveland Worm & Gear Div.
Eaton Mfg. Company
Cleveland, Ohio

JOHN J. SHERLOCK
National Carbon Co. (UCC)
Cleveland, Ohio

PITTSBURGH

CLEMENT R. LAWRENCE
United States Steel Corp.
Homestead, Pennsylvania

LOS ANGELES

DANIEL F. FRAZIER
Texaco, Incorporated
Wilmington, California

EDWARD L. LA BASS
Lincoln Engineering Co.
Los Angeles, California

DONALD G. PIKOULAS
Texaco, Incorporated
Los Angeles, California

NEW YORK

SEBASTIAN BORDONARO
E. I. du Pont de Nemours & Co.
Parlin, New Jersey

PHILADELPHIA

RICHARD H. FOWLER
E. F. Houghton & Co.
Philadelphia, Pennsylvania

DAYTON

JAMES A. ASHBAUGH
Minster Machine Company
Minster, Ohio

HOMER R. MONCE
The American Lubricants Co.
Dayton, Ohio

ST. LOUIS

HARRISON BROCKMEIER
Century Electric Company
St. Louis 3, Missouri

GEORGE F. HEATH
George F. Heath Company, Inc.
St. Louis, Missouri

HAL B. WOODUL
George F. Heath Company, Inc.
St. Louis, Missouri

HOUSTON

BURL B. BABER, JR.
Southwest Research Institute
San Antonio, Texas

CENTRAL OHIO

EMERSON D. HOLMAN
Kaiser Aluminum & Chemical Corp.
Newark, Ohio

BOSTON

JOHN F. BURNS
Shell Oil Company
Waltham, Massachusetts

RAIMUND F. O'BRIEN, JR.
The California Oil Company
Boston, Massachusetts

CINCINNATI

ROBERT T. KENNEDY
American Lubricants Company
Dayton, Ohio

MONTREAL

ANDRE GAGNE
Imperial Oil Limited
Montreal, Que., Canada

CHICAGO

WAYNE E. BESSETTE
Carlisle Chemical Works, Inc.
Naperville, Illinois

ROBERT L. LOGELIN
Sinclair Refining Company
Homewood, Ill.

PUGET SOUND

ROBERT C. CUFFEL
Standard Oil Co. of Calif.
Seattle, Washington

INTERMOUNTAIN

VINCENT H. MILLER (R)
Continental Oil Company
Salt Lake City, Utah

UNAFFILIATED

LAURENCE J. HOFFMAN
Lone Star Steel Company
Lone Star, Texas

GRAYDON LEY
Anaconda Aluminum Company
Terre Haute, Indiana

THOMAS W. McCULLOUGH
The Martin Company
Denver, Colorado

HAROLD L. OWEN
Riegel Textile Corporation
Ware Shoals, South Carolina

JOHN S. ROBERTS
Continental Oil Company
Billings, Montana

FOREIGN

JAMES BATE
Shell Co. of Thailand Limited
Bangkok, Thailand

COLIN FREDERICK SMITH (R)
Rolls-Royce Limited
Derby, England

Below is a dinner scene from the recent symposium on Lubrication for Metal Processing sponsored by the ASLE Connecticut Section. Also shown are the symposium speakers: left to right—John Mueller, Director of Research, Carborundum Corp.; A. W. Ackerman, Vice President-Technical Director, F. E. Anderson Oil Co.; Robert A. Fitch, Gulf Research and Development Corp.; Ernest Brancroft, Metallurgist, Pratt and Whitney Co.

SECTION NEWS

Montreal—The technical session of the June meeting featured guest speaker Peter Kettlewell (G. I. Mech. Eng., A. F. Inst. Pet., Rocol Ltd., Swillington, Leeds, England). His subject was entitled, "The Theory and Practice of Molydenum Disulphide Lubrication." . . . **Baltimore**—The May meeting featured a Ladies Night Banquet and the installation of officers for the 1960-61 year. . . . **Youngstown**—Fifty-five members turned out for the May meeting to hear Dr. Robert C. Williams, Research Department of Ironsides of Columbus, Ohio, speak on the subject of "Roll Oils." The members held their annual golf outing and party on June 15. . . . **Duluth-Iron Range**—Following the social and dinner hour of the May meeting, Don Ricketts, Southwest Grease and Oil Co. Inc., Wichita, Kansas, spoke on "The Manufacture and Application of Lubricating Greases." . . . **Connecticut**—The annual report of the section chairman, Harold A. Geer, showed excellent programming for the year, with three of its own section members delivering the technical portions of the program. The monthly attendance average has been 44. Arnold Ackerman won the award for the best regional paper given in 1959 at a Boston meeting last spring. Last year, the Connecticut Section won a plaque and award in Group II for the section making the most progress in membership. . . . **Los Angeles**—Discussion at the May meeting covered the type of lubricating greases in future demand, the outlook for dollar volume of greases, and future grease packaging. The speaker was Keith H. Birkett, Director of Lubricant Laboratories, Battenfeld Grease and Oil Corp., Kansas City, Mo. The June meeting was a field trip on the ship "Shearwater" for members and their immediate families only. . . . **Chicago**—Prof. Robert B. Banks, Technological Institute, Northwestern University, was featured at the May meeting. His subject was "Fundamentals of Oil Hydraulics." Starting with the fundamental laws of fluid flow, he also reviewed available courses for engineers interested in hydraulic power. The annual golf outing was held on June 16. . . . **Syracuse**—The topic of Investments was discussed by Robert Sheridan, Investment Trust Corp., New York, N. Y., at the year's last monthly meeting. Mr. Sheridan's subject included insurance, real estate, and common stock. . . . **Twin Cities**—Following an afternoon plant tour of the George A. Hormel Co., the May 19 dinner meeting featured M. L. Carter, Vice President and Chief Chemist of the Southwest Grease and Oil Co. Mr. Carter presented interesting demonstrations along with his discussion of recent developments in greases. . . . **Houston**—Sixteen members and three guests were present at the May meeting. Following the social hour and dinner, the ballot committee reported the results of the election of the officers for the 1960-61 business year as follows: chairman, A. Warren Elrod; 1st vice-chairman, Gayle Chaffin, 2nd vice-chairman, Harvey Benoit; secretary, Irving Pollock; treasurer, Clyde M. Floyd. The speaker at the meeting was Val Jean McCoy of Shell Oil Company, who talked on "Public Relations is Everybody's Business." . . . **Hudson-Mohawk**—At the May meeting, R. E. Lee, Jr. was elected chairman for the 1960-61 season. Mr. Lee is Bearing Materials Engineer in the General Engineering Laboratory of the General Electric Company in Schenectady. Dr. R. V. Klint was elected vice-chairman and S. F. Murray, secretary-treasurer. The directors for the coming season are J. P. Ressig, R. B. McBride, E. S. Preble, and Dr. A. A. Schwartz. . . . **Rochester Section**—All attendance records were broken when the Rochester Section held its first "Management Night" at the University Club. A. R. Eckberg, Manager of Engineering, Construction, Maintenance and Utilities at the Kodak Park Works delivered an unusually interesting talk entitled "Management's Evaluation of an Industrial Lubrication Program." Although the membership of the Rochester Section is only 38, this first-of-its-kind affair in Rochester drew another 40 people representing management in Rochester industry. The talk did not touch on any of the technical aspects of lubrication but very appropriately dealt with the dollar and cents value of a well-planned and integrated lubrication program. Program chairman, William Signer, was general chairman of the affair. . . . **Pittsburgh**—At the final meeting of the 1959-60 year on May 12, with 39 in attendance, the following officers for the 1960-61 year were elected: Chairman, R. C. Garretson, (Westinghouse Electric Corp.); Vice-Chairman, D. W. Howard, (Gulf Oil Corp.); Secretary, R. L. Nourie, (L. R. Nourie Co.); Treasurer, H. M. Kaufman, (Westinghouse Research Labs). R. W. VanSant, Jr., Director, Marketing Service Division, Gulf Research and Development Co., Pittsburgh, Pa., spoke on "How Formulation Influences Lubricating Oil Performance." The Section's Summer Social was held on June 10, 1960. . . . **Toronto**—The ninth regular monthly meeting, held on May 10, 1960, was preceded by a plant tour through Canada Packers Limited. The guest speaker, Mr. W. D. Gossett, conducted a discussion period on the problems of lubrication in a packing plant.

Shown at the Rochester Section's first "Management Night" meeting is (left to right) A. R. Eckberg, speaker at the occasion; R. H. Knowe, Chairman, Rochester Section; R. G. Forsythe, Sr., Chairman, Hamilton Section; D. A. Hall, Treasurer, Rochester Section; and C. L. Miller, Past Chairman, Rochester Section.

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Lubrication Engineering

dollars and sense

During the past months there has been a lot of hullabaloo about a set of "laws" as given to the world by C. Northcote Parkinson, a noted British humorist. The first one goes something like this: "Work expands so as to fill the time available for it's completion." And the second one: "Expenditure rises to meet income!

There can be no doubt that there is a good deal of wisdom contained in these succinct thoughts. For a moment, one might get the idea (on the basis of these two laws) that Parkinson has devoted a good amount of his time to engineering societies and their operations—and more specifically in the field of finances. It has been suggested that perhaps Parkinson's second law ought to be modified to something like this—"Expenditure rises without regard to income" or , "All should live within their means, even if they have to borrow to do so!"

Nonetheless, Mr. Parkinson has obviously pin-pointed a real engineering society situation in his second law, "Expenditure rises to meet income." While this law was expressed by Parkinson in a humorous vein, it can be applied with all sincerity in the case of engineering societies. Perhaps this is how it should be.

Of course, every group should have a *reserve fund* to be used when the sun is not shining so brightly. Most of the "experts" say this should be about a year's operating expenses. But over and beyond this reserve, certainly a society should plough back all of its income into programs and activities. We aren't in business to make money. Our objective is to educate, through programs, activities and publications. With this noble purpose in mind, it seems that our job is to *best spend* all of the revenue of the Society. Our problem is *how* should it be spent. The selection of the program or activity to be undertaken is the task that we face. We hope we can do it judiciously. As a member of ASLE you can help steer the course of your society. Through your suggestions and ideas perhaps we can accomplish this job.

In wrapping up this billet-doux, it should be added that this financial philosophy is *not* recommended for industry or government, but surely this is precisely what a society, such as ASLE ought to do.

L. O. Witzenburg
President, ASLE

Spur Gears - Hertzian Contact Times

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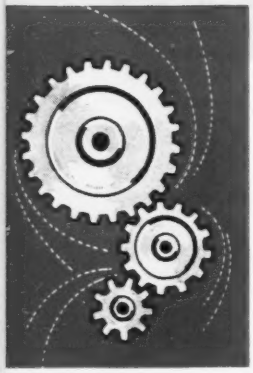


Presented before the 14th ASLE Annual Meeting, Buffalo, N. Y., April, 1959

The contact time between mating gear teeth is important in the study of the stress gradients developed in high-speed gears, and in dynamic lubrication processes where the finite time required for acceleration and viscous flow of lubricant escaping from the contacting area must be considered. Contact times also enter into lubrication processes when the characteristics of a dynamically loaded lubricant film depend on the rate of loading, such as the behavior which has been observed with ultra-rapid loading rates. In this paper, the definition of contact time is based on the half-width of a band of contact. Contact areas for five phases of contact are of special interest; those at (A) the first point of contact, (B) the first point where a single pair of teeth take all the load, (C) the pitch point, (D) the point where more than one pair again share the load, and (E) the last point of contact. Expressions are developed for (A) the contact ratio, (B) the Hertzian contact stress, and (C) the Hertzian contact time for all five phases of contact. These relations apply directly to gear teeth with involute profiles, without consideration for deformation due to lubricant action.

INTRODUCTION

The contact time between mating gear teeth is important in the dynamics of gears and of gear lubrication, and may well be a key factor in studies of the stress gradients in high-speed gears and similar areas of research. The contact time is also important in the investigation of dynamic lubrication effects, where the finite time required for acceleration and viscous flow of lubricants escaping from the contact point must be considered. Contact time also enters into the gear lubrication process because dynamically loaded lubricant films exhibit quite varied physical characteristics when loaded for periods of time which are short in comparison with lubricant relaxation times. In this paper we develop equations for the Hertzian contact times for non-fouling involute spur gears from the kinematic relations involved. Analytic expressions are thereby provided which apply directly to the case of the involute gear tooth profile. But the form of these expressions is such that with suitable modification they may be extended by numerical means to provide contact times for real profiles which deviate from the involute, so allowing for arbitrary deviations such as given by tip relief or by tooth error.

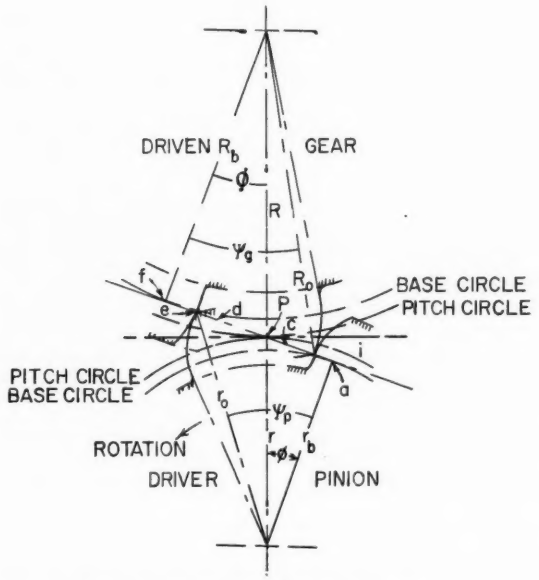
DEFINITION OF CONTACT TIME

The period of time in which any specified portion of a gear tooth is in contact with a mating surface depends on several factors, important among which are the rotational speed, the gear geometry, and the amount of elastic deformation introduced by the applied load. In defining the contact time, it is preferable to base the definition on a contact area rather than on the position of a line of contact. If the contact time is associated with a contact area, then the volume of lubricant contained within the confined and dynamically loaded film is also specified.

For a definition of gear tooth contact time, a reference area equal to the product of the face width and the half-width of the band of contact is taken, and the contact time at any phase is the time required for the center of contact to move a distance equal to this half-width. This contact time is the maximum time which any single portion of the lubricant is completely contained between the "contacting" surfaces. This time is identified as a "Hertzian" contact time when the half-width of the contact band is that computed from the Hertzian equations which neglect deformation of the tooth profile due to lubricant action.

KINEMATIC RELATIONS

Fig. 1 indicates a pinion and gear, with the pinion acting as a driver and revolving counterclockwise. The initial point of contact of any given pair of teeth is made at some point such as represented by (i) in this diagram; later this same pair of teeth make contact at other points such as (P), the pitch point, and at point (e), the last point of contact. These points lie along the line of contact (line of action), and it is convenient to locate them in terms of their distances from reference points (a) or (f). Reference point (a) marks the point of tangency of the line of action with the base circle of the pinion; likewise point (f) is the point of tangency with the base circle of the gear. The pressure angle ϕ defines the orientation of the line of action with respect to a line through the pitch point that is normal to the line of centers. The center distance is represented as C; the distance between the reference points (a) and (f) so becomes equal to $C \sin \phi$.



SPUR GEAR GEOMETRY AT THE INITIAL AND FINAL POINTS OF CONTACT

Fig. 1. Spur Gear Geometry at the Initial and Final Points of Contact.

The radius of curvature of the tooth profiles must be established in order to compute the reference areas on which contact time is based. From the geometry of involute gears, the radius of curvature of the pinion tooth profile, at any phase of contact, can be represented by the distance of the contact point from reference point (a). Thus $\overline{ai} = (\rho_p)_i$, where $(\rho_p)_i$ is the radius of curvature of the pinion for contact phase (i). Likewise the radius of curvature of the gear tooth surface can be represented by a distance from reference point (f); thus, $\overline{fd} = (\rho_g)_d$, where the symbolism indicates a radius of curvature for the gear for contact phase (d).

There are five phases of contact between the mating teeth that are of special interest. These are at the initial point of contact (i), at point (c) where a single pair of teeth first take all the load, at the pitch point (P), at point (d) where more than one pair of teeth again share the load, and the last point of contact at (e). For three of these, points (i), (P), and (e), the radii of curvature are given directly by the geometry of the figure. For this purpose, it is convenient to define angle ψ = arc cos (base radius)/(outside radius) for the pinion or gear respectively. Thus for the pinion, $r_b = r_o \cos \psi_p$, and for the gear, $R_b = R_o \cos \psi_g$. Considering the radius of curvature for the pinion at point (i) as an example, $(\rho_p)_i = \overline{ai} = \overline{af} - \overline{if} = C \sin \phi - R_o \sin \psi_g$. This relation is included in the summary table below. Concerning point (c) it may be observed that (for gears having an average number of pairs of teeth in contact greater than one, but less than two) point (c) is located so that contact at this point precedes phase (e) by a base pitch central angle of rotation. That is, $\overline{ac} = \overline{ae} - p_b$, where p_b is the base pitch for the gears. Likewise, point (d) can be located by noting that phase (d) follows phase (i) by this same base pitch central angle of rotation.

A summary of the relationships for the radii of curvature for each of the various contact phases is as follows.

Radius of Curvature

point (i)	$(\rho_p)_i = C \sin \phi - R_o \sin \psi_g$	[1]
	$(\rho_g)_i = R_o \sin \psi_g$	[2]
point (c)	$(\rho_p)_c = r_o \sin \psi_p - p_b$	[3]
	$(\rho_g)_c = C \sin \phi - r_o \sin \psi_p + p_b$	[4]
point (P)	$(\rho_p)_P = r \sin \phi$	[5]
	$(\rho_g)_P = R \sin \phi$	[6]
point (d)	$(\rho_p)_d = C \sin \phi - R_o \sin \psi_g + p_b$	[7]
	$(\rho_g)_d = R_o \sin \psi_g - p_b$	[8]
point (e)	$(\rho_p)_e = r_o \sin \psi_p$	[9]
	$(\rho_g)_e = C \sin \phi - r_o \sin \psi_p$	[10]

These expressions for the radii of curvature provide values for any of the five contact phases of interest solely in terms of the geometry and dimensions of the pinion and gear. For computation of gear tooth contact times, these radii are used first to compute the Hertzian stress and the corresponding half-width of the band of contact. For n pairs of contacting teeth, and for a Poisson ratio of 0.3, (1)

$$q_o = 0.418\left(\frac{WE(\rho_p + \rho_g)}{nF(\rho_p \rho_g)}\right)^{1/2} \quad [11]$$

where q_o is the maximum contact stress, Q the transmitted load, E the modulus of elasticity, and F the face width. The corresponding expression for b, the half-width of the band of contact, becomes

$$b = 0.635 \frac{W}{nFq_o} \quad [12]$$

The number of pairs of teeth in contact may be obtained by dividing the total length of the line of contact ($\overline{ie}$) by the base pitch p_b. Expressed in terms of the indicated radii of curvature:

$$\text{Contact ratio} = \overline{N} = \overline{ie}/p_b = [(\rho_p)_e - (\rho_p)_i]/P_b \quad [13]$$

A value as so computed may be misleading, however, for fractional contact has no physical significance. An average contact ratio such as 1.530 indicates only that either one pair of teeth or two pairs of teeth are in contact. The appropriate integer for a given phase of contact, n in the above formula, is chosen from the computed average value $\overline{N}$ by inspection of the gear diagram. For the gears as shown, $n = 2$ for initial phase (i) and final phase (e). At phase (c) n changes discontinuously from a value of two to a value of one, and inversely at contact phase (d). At the pitch point (P), $n = 1$.

The band of contact for a loaded gear represents a chord along the arc of its generating involute, the length of which is substantially that of the arc. From the geometry of involute gears, a differential length of arc, dS, is given in terms of a central angle θ as

$$dS = r_b\theta\, d\theta \qquad [14]$$

where $r_b\theta$ = arc θ. For any phase of contact, arc θ for the pinion is represented as the distance between the contact point and reference point (a) and is also the radius of curvature for the pinion tooth surface at that point. The length of the arc of the involute, dS, corresponds to the small distance b along this involute, hence

$$d\theta = \frac{ds}{r_b\theta} = b/(\rho_p) \qquad [15]$$

for the pinion, with a corresponding expression for the gear. Contact time varies inversely with the angular velocity, so that contact time becomes $d\theta/\omega$ where ω is the angular velocity. Hence

$$\text{contact time (pinion surface)} = \frac{b}{\omega_p(\rho_p)} \qquad [16]$$

$$\text{contact time (gear surface)} = \frac{b}{\omega_g(\rho_g)} \qquad [17]$$

From the standpoint of the lubricant, the shorter of these two computed contact times indicates the maximum time any particular portion of lubricant is subjected to continuous load.

It can be seen that this computation of hertzian contact times requires, as intermediate items, values for the hertzian stress and contact areas. Other items of interest in the kinematic analysis of gears are also readily obtained during the course of the computation. Thus the value of the maximum sub-surface shear stress becomes,

$$\tau \text{ max.} = 0.304q_0 \qquad [18]$$

and the depth Z_1 below the surface of this maximum shear stress is given by

$$Z_1 = 0.78b \qquad [19]$$

The velocity of roll for a tooth surface at any point is given as the product of its angular velocity and radius of curvature (2). Thus

$$\text{Velocity of roll (pinion)} = \omega_p\rho_p \qquad [20]$$

$$\text{Velocity of roll (gear)} = \omega_g\rho_g \qquad [21]$$

The velocity of sliding for any phase of contact is by definition the algebraic difference in the values for the velocity of roll for pinion and for the gear tooth surfaces. That is

$$\text{Velocity of sliding} = \omega_p\rho_p - \omega_g\rho_g \qquad [22]$$

for any phase of contact.

The position of any specific point along the pinion tooth surface follows from Eq. [14] when integrated. The length of the arc of the involute, S, in terms of central angle θ, becomes

$$S = (r_b/2)(\theta_2^2 - \theta_1^2) \qquad [23]$$

But $r_b\theta$ represents the radius of curvature for the pinion surface. Selecting the pitch point as a point of reference, the distance d from the pitch point along the pinion surface becomes

$$d = \frac{1}{2r_b}(\rho^2 - \rho_P^2)_p \qquad [24]$$

with a corresponding expression in terms of R_b for the gear.

SAMPLE CALCULATIONS

A practical problem in which these theoretical relationships are of some concern is in connection with the comprehensive work reported by Borsoff (3). Run number 575 from his report has been selected as a basis for an illustrative example. Data for this particular gear test run is listed in Table 1.

The radius of curvature is computed by the pertinent Eq. [1] through [10]. Thus, for the pinion in the initial contact phase, Eq. [1] applies. The pressure angle ϕ is given as 20°, but angle ψ_g must be computed. Cos ψ_g = (1.4878)/(1.7500) whence ψ_g = 31.77°, as included in Table 1. Then,

$$(\rho_p)_i = 3.000 \sin 20° - 1.7500 \sin 31.77° = 0.1047''$$

This and other radii are shown in the following table for each phase of contact.

To find the Hertz stress, the actual number of pairs of teeth in contact must be known. Solving first for the average contact ratio, by Eq. [13]

$$\overline{N} = (0.8570 - 0.1047)/(0.4918) = 1.530$$

TABLE 1—TEST GEAR DATA (REF. 3)

	PINION	GEAR
Diametral Pitch	P = 6	P = 6
Center Distance, inches	C = 3.000	C = 3.000
Pressure Angle, degrees	ϕ = 20	ϕ = 20
Face Width, inches	F = 0.25	F = 0.25
Circular Pitch	P_c = 0.5236	P_c = 0.5236
Base Pitch	P_b = 0.4918	P_b = 0.4918
Addendum, inches	a = 0.1666	a = 0.1666
Contact Ratio	$\overline{N}$ = 1.530	$\overline{N}$ = 1.530
Transmitted Load, lb.	W = 283	W = 283
Number of Teeth	N_p = 17	N_g = 19
Pitch Radius, inches	r = 1.4167	R = 1.5833
Outside Radius, inches	r_0 = 1.5833	R_0 = 1.7500
Base Radius, inches	r_b = 1.3312	R_b = 1.4878
Angle ψ, degrees	ψ_p = 32.78	ψ_g = 31.77
Angular Velocity, radians/second	ω_p = 523.6	ω_g = 468.5

TABLE 2—ANALYSIS OF GEAR OPERATING CONDITIONS

CONTACT PHASE	POSITION ALONG FACE OF PINION									
	(i)	(c)			(P)	(d)			(e)	
Radius of curvature, pinion ρ_p, inches	0.1047	0.3652			0.4845	0.5972			0.8570	
Radius of curvature, gear ρ_g, inches	0.9214	0.6616			0.5415	0.4296			0.1690	
No. of Pairs of Teeth in Contact (n)	2	2	1		1	1	2		2	
Maximum Hertz stress, q_0, psi	177,500	112,000	158,500		152,300	154,000	108,900		144,900	
Half-width of band of contact, b, inches	0.00203	0.00321	0.00454		0.00472	0.00467	0.00330		0.00248	
Velocity of roll, pinion, inches per second	55	191			254	313			449	
Velocity of roll, gear, inches per second	432	310			254	201			79	
Velocity of sliding, inches per second	−377	−119			0	+112			+370	
Contact time, pinion surface, microseconds	37.0	16.8	23.7		18.6	14.9	10.6		5.5	
Contact time, gear surface, microseconds	4.7	10.4	14.6		18.6	23.2	16.4		31.3	
Maximum lubricant contact time, microseconds	4.7	10.4	14.6		18.6	14.9	10.6		5.5	
Distance from pitch point along pinion surface, in.	.084	.038			0	.046			.188	

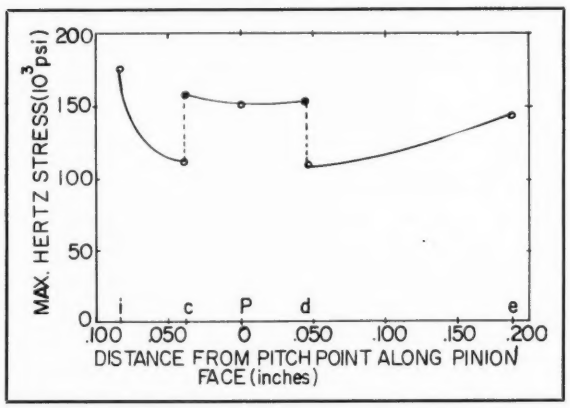


Fig. 2. Computed Values for Hertz Stress

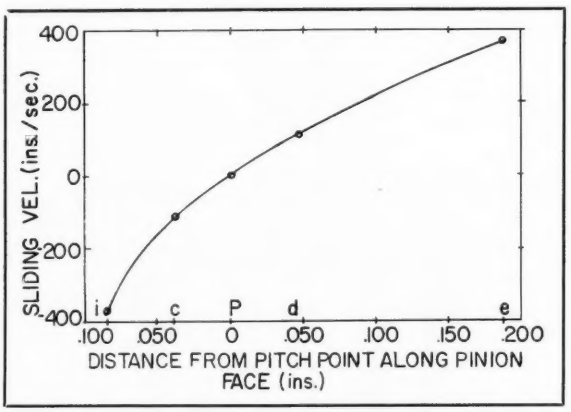


Fig. 3. Computed Values for Sliding Velocity

Hence, the pertinent integer is either $n = 1$ or $n = 2$, as shown in Table 2. For the maximum hertzian contact stress at the initial phase of contact, by Eq. [11]

$$q_o = 0.418\left(\frac{283 \times 30 \times 10^6(0.1047 + 0.9214)}{2 \times 0.25(0.1047 \times 0.9214)}\right)^{1/2}$$

$$= 177{,}500\ psi$$

Here a modulus of elasticity of 30×10^6 has been assumed.

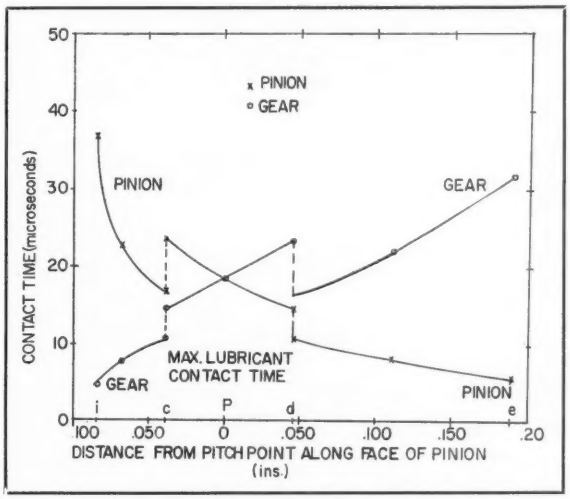


Fig. 4. Computed Values for Various Contact Times

Corresponding computation for the half-width of the band of contact is by Eq. [12] as

$$b = (0.635 \times 283)/(2 \times 0.25 \times 177{,}500) = .00203''$$

The contact time, for the pinion surface at phase (i) is given by Eq. [16] as

$$\text{Contact time} = \frac{.00203}{523.6 \times .1047}$$

$$= .0000370 \text{ secs, or } 37.0 \text{ microseconds.}$$

These and other items are included in Table 2. Computed values for Hertz stress, sliding velocity, and the various contact times are shown graphically in Figs. 2, 3, 4.

REFERENCES

1. Timoshenko, S., "Theory of Elasticity," Engineering Societies Monograph, McGraw-Hill Book Company, Inc., 1934, pp. 350.
2. Merritt, H. E., "Gears," Pitman, London, 3rd ed., 1954, pp. 99.
3. Borsoff, V. N., "On the Mechanism of Gear Lubrication," ASME Paper No. 58-LUB-4, 1958.

A Survey of Lubrication Methods

Part 3- Compendium of Lubricating Devices

(Continued)

This is the third article in this part

by Allen F. Brewer*
Consulting Editor

Illustrated by Robert R. Wayne
Pittsburgh, Pa.

In the present issue, as in the last two issues, the main features of typical lubricating devices will be discussed. Again the illustrations have been kept quite schematic to stress the principle of operation rather than the details of construction.

OILED-AIR LUBRICATORS

One way of carrying oil to the lubrication points of a machine is the air suspension method. There are a number of different devices that employ this method. In the common type shown in Fig. 18, air is made to flow through the device and air pressure acting on the oil in the reservoir tends to force the lubricant up a tube to the feed adjustment valve. The air stream passes through a venturi section and the pressure decreases to a minimum at the venturi throat. An oil inlet is located at the throat through which lubricant flows due to the pressure difference existing between the feed adjustment valve and the venturi throat. The oil, atomized by the air stream, is carried along to the machine parts to be lubricated.

Oiled-air devices are often used to lubricate high speed rolling contact bearings and various pneumatic tools.

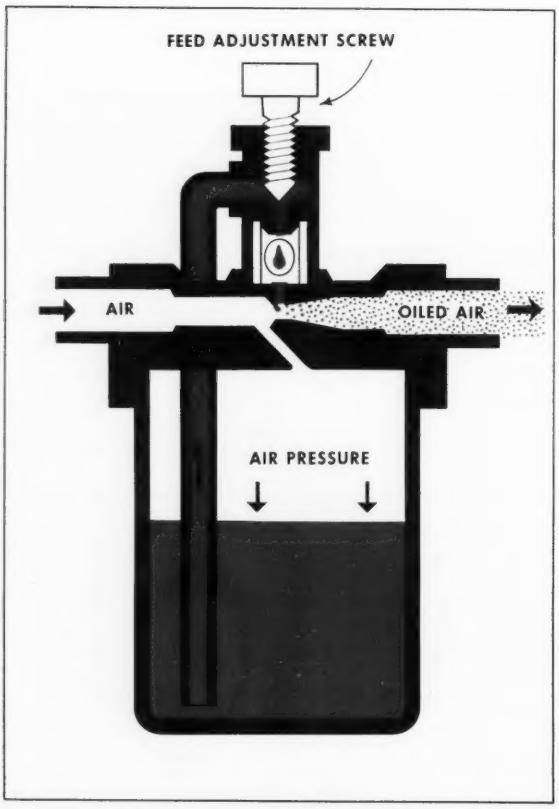


Fig. 18. Oiled-Air Lubricator

* Consultant and author "Basic Lubrication Practice."

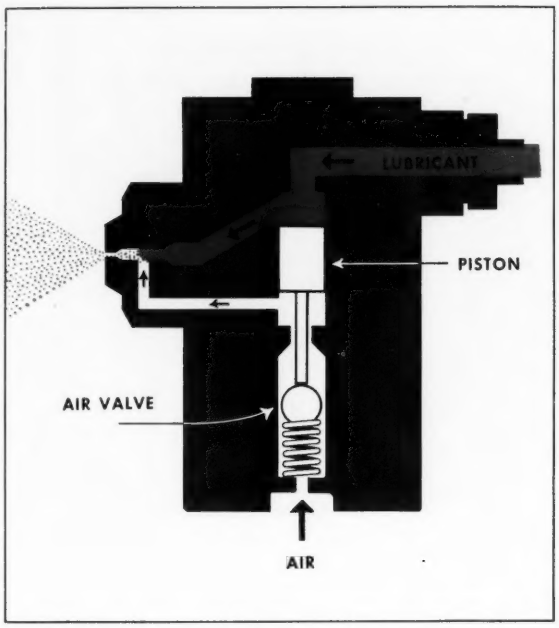


Fig. 19. Spray Valve

SPRAY VALVES

The typical spray valve shown in Fig. 19 has separate air and lubricant supply lines. Pressurized lubricant entering the spray valve actuates a piston which opens the air check valve. The air and lubricant mix in the nozzle area to form a spray. Spray valves are usually used in conjunction with a timing and metering system to permit measured amounts of lubricant to be dispensed at selected intervals of time. Spray systems are frequently used for lubricating open gears and sliding surfaces.

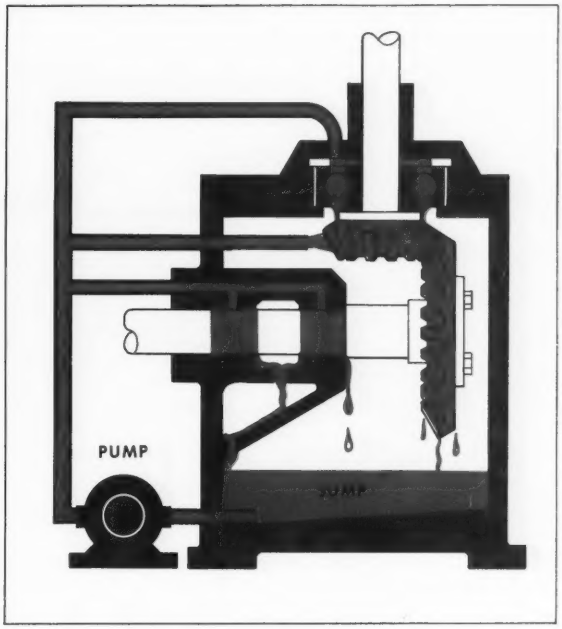


Fig. 20. Wet Sump Circulating System

PRESSURE CIRCULATING SYSTEMS

For many applications involving fairly high loads and speeds, pressure circulating systems are most effective. In addition to supplying oil as a lubricant, such a system also utilizes the oil as a cooling medium for the bearings.

There are three main types of circulating systems generally used, (1) Wet sump (2) Dry sump (3) Gravity Feed.

Figure 20 shows a schematic wet sump system in which oil is pumped under pressure directly from the sump to the lubrication points. The oil returns to the sump by gravity. The wet sump system is commonly used on automobile and other internal combustion engines. The main disadvantage of such a system is that a pump failure will cause almost immediate starved conditions at the lubrication points.

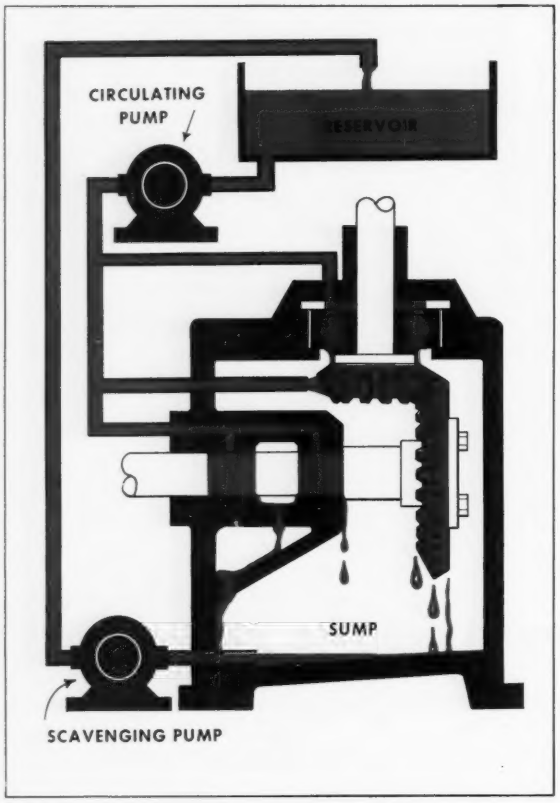


Fig. 21. Dry Sump Circulating System

Figure 21 shows a schematic dry sump system. The lubrication points are supplied with oil from the circulating pump. The circulating pump draws lubricant from an oil reservoir, usually located above the lubrication points, that is constantly replenished by a scavanging pump. The scavanging pump in turn draws its oil from the sump into which the lubricant flows after passing through the lubrication points. The scavanging pump always has a greater capacity than the pressure pump hence the sump remains practically dry. A pump failure in the dry sump system will not result in as rapid a failure as would occur in the wet sump system, as oil can flow under gravity from the upper oil tank to the lubrication points. In addition there is some advantage to be gained from the point of view of reducing oil oxidation and contamination in storing the oil in a separate tank rather than in the sump or crankcase.

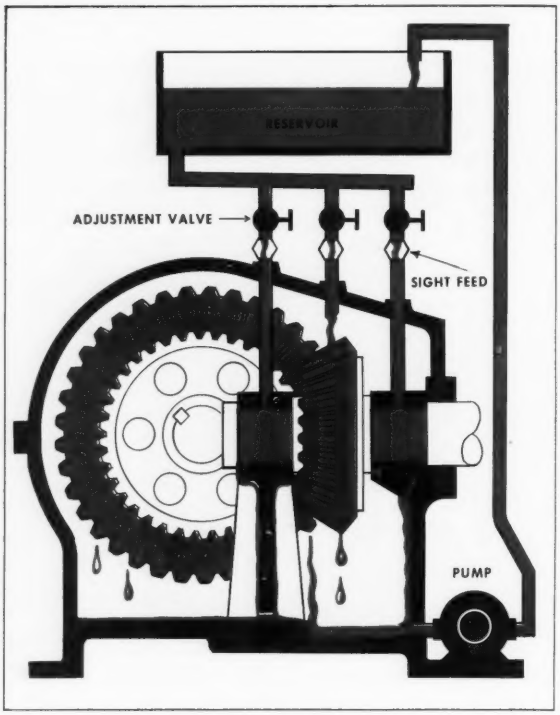


Fig. 22. Gravity Circulating System

Figure 22 shows a typical gravity feed system. It is similar to the dry sump system except that the pressure pump is eliminated and oil flows to the lubrication points under gravity from a tank supplied by a scavanging pump. The oil delivery pressure is set by the height at which the tank is located above the machine, thirty feet being a representative average figure. Regulating valves are often placed in the supply line to each lubrication point and some sort of sight feed window or indicator is commonly provided.

In addition to the basic components described, circulating systems usually require other auxilliary accessories such as oil filters and coolers to condition the lubricant, and various alarm systems to warn against malfunction of important units such as the pumps.

(To be continued)

A New Approach to the Lubricating Problems of Internal Combustion Engines

by F. A. Kirigin

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A better understanding of the internal combustion engine process will be obtained, not only by a wider knowledge of the isolated physical and chemical phenomena occurring in the working engine but also by envisaging the interlacement of such phenomena.

A new approach to lubrication problems is outlined. In this, consideration is given not only to the isolated physical and chemical phenomena occurring but in addition this method emphasizes the interconnections of laws and factors involved.

The proposed scheme is illustrated by applying it to the compression ignition engine.

The lubrication problems appearing as the consequence of ever more exacting requirements put on internal combustion engine performance are essentially very intricate. This complexity stems from the existence of many factors involved in the process (characterised by engine design, fuel and lubricating oil quality, working conditions) and by the mutual dependence of these factors. Therefore, one can easily understand that at first the lubrication problems were envisaged purely on an empirical basis.

In the earliest stages, tradition and experience have in many instances given good results but there was little or no scientific basis underlying the study of lubrication problems. In this period such quantities as the carbon residue and even the color were criteria for oil evaluation.

In the second period, the development of ideas explaining combustion and lubrication phenomena in engines tended to free itself from the empirical approach and to define with more precision the factors to analyse the facts more rationally and to augment the knowledge of the physical and chemical phenomena taking place in the engine. The research work of this period was characterised by the study of single isolated phenomena in the working engine as a part of the integral process. Thus, the causes of engine wear, the deterioration and sludge formation in lubricating oils, the nature of the sludge, and the ways for eliminating their undesirable effects were studied.

In the next phase, work appeared in which the lubrication problems were studied integrally i.e., most if not all, the phenomena were studied from one standpoint. Characteristic examples for this type of work were the papers presented at the Third (1) and on the Fourth (2) World Petroleum Congress and on the Conference on Lubrication and Wear held in London in Oct. 1957 (3).

In the immediate future, work may be expected having as its goal an extensive knowledge concerning single physical and chemical phenomena, and also a better understanding of the engine process in its complexity. In fact many lubrication problems originate in the insufficient knowledge of the process as a whole, i.e. in the lack of understanding concerning the interrelations of certain factors characterizing the process.

Therefore, it seems useful to illustrate the internal combustion engine process in a way to emphasize mutual causal links and relations between the factors involved in order to get a more complete picture of the process as a complex phenomenon. It is not only important from this point of view to know all the physical and chemical laws governing the process, but it is also essential to see how the phenomena are interconnected, in other words, how the laws governing the process act jointly.

Technological processes in general will be considered first to get a clear picture of how the laws act jointly in the internal combustion engine process. Any technological process may be considered as a display of natural laws acting jointly, directed by human intelligence for the purpose of producing either some useful material or energy.

In order to study the modes of joint action of natural laws in the technological process, the simple forms of the process will be separated and be con-

sidered individually. It will be shown that such simple forms of joint action of laws are typical and that they will be found in any complex technological process.

Such forms of joint action of laws will be represented by models. But before describing them, it will be useful to recall the concept of enforced movements. Any limitation of movement is called a linkage in mechanics. Any linkage is mathematically represented by an equation or inequality depending on the linkage being detaining or non-detaining. By means of a linkage enforced movements are made.

An example of enforced movement is a material point which is allowed to move on the surface of a sphere only (detaining linkage) or which is allowed to move outside the sphere only (non-detaining linkage). Another example is the mechanism of an internal combustion engine, in which case many linkages are acting. On one hand we have the linkages which assure the shape invariability of rigid bodies and on the other the freedom of movement of these bodies as limited by other linkages. Thus, the fixing of the journal pins in the bearings limit the freedom of movement of the journal, and the freedom of movements of the crosshead is limited by the crosshead guides, etc.

The notion of linkage may be extended from mechanics to technological processes. In this case, under the notion linkage, we understand any design condition which limits the freedom of movement of the system, and which otherwise would occur under the compulsion of forces. As examples of this we may cite a pressure vessel (which limits the expansion of gases), a filter (which allows the passage of liquids but not of solids), etc.

By means of linkage enforced movements are performed. The linkage, therefore, represents a means for directing and exploiting natural laws. By means of them human activity influences the natural environment. In the case of a technological process this goal is attained by the shape of the apparatus, i.e. by the design characteristics of the plant.

Therefore, we must bear in mind that in the case of description of single forms of natural laws acting jointly these forms of common action depend on the design structure of the apparatus in which the technological process takes place.

The following are some examples (or models) of simple forms of natural laws acting jointly:

(a) Additive joint action of laws.

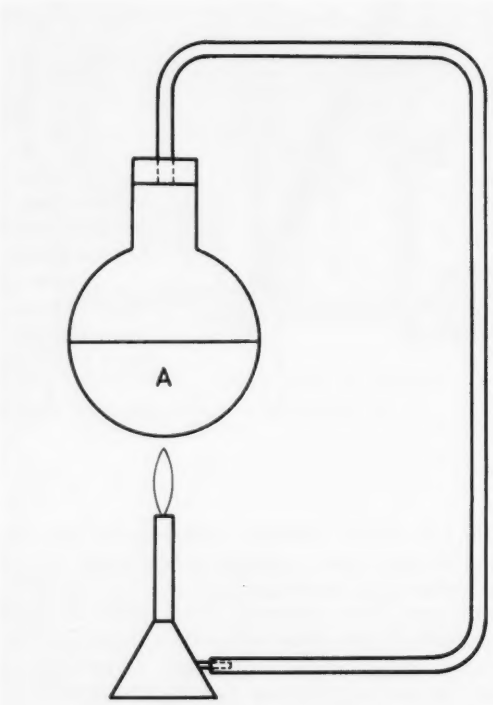


Fig. 2. A model for the joint action of natural laws. Two laws are mutually connected in such a manner that the cause of the first is the effect on the second and vice versa.

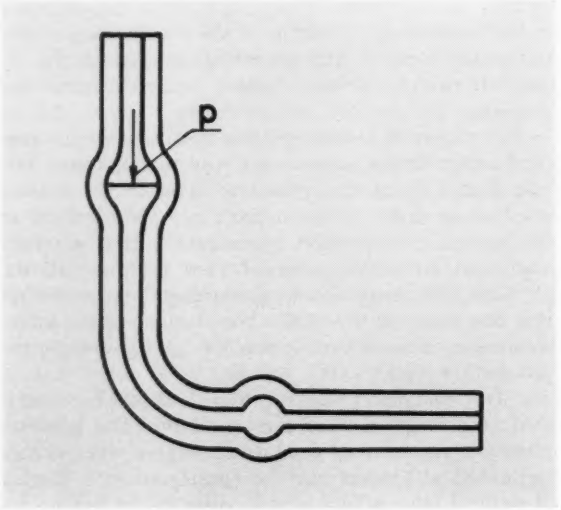


Fig. 1. A capillary tube of a Poiseuille viscometer can be taken as a model for joint action of two natural laws. The gravity and the pressure on the surface of the liquid act additively.

Considering a liquid in a capillary tube as used in Poiseuille viscometer (Fig. 1) on which the forces of gravity and pressure p are acting. The effect of these actions will be the movement of the liquid, which may be measured by the flow velocity v. In this case the form of joint action of the two laws may be represented schematically as in Fig. 3a. The points represent quantities and the lines laws by which the quantities are mutually depending. In this example the force of gravity and the pressure act additively.

(b) Case in which the effect reacts on the cause.

The model for such forms of action may be represented as in Fig. 2. The vessel A contains a volatile liquid, e.g. octane. The octane is vaporized by heating and the vapours are conducted to the burner under the vessel A. Heating (cause) transforms the liquid

into vapour (effect) and the vapour in turn generates, by combustion, the heat necessary for further evaporation of the liquid octane. The laws governing this process are mutually connected in such a manner that the cause of the first is the effect of the second and vice versa. The first is the law of evaporation of a liquid governing the rate of evaporation of a liquid resulting from a given heat input and the second tells us how much heat the combustion of a given quantity of combustible vapour will develop.

In this example, two laws acting jointly are involved and are mutually connected in the manner schematically represented in Fig. 3b.

(c) Chain sequence of laws, i.e. the effect of the preceding law is the cause of the following.

An example of this type of connection would be in the fueling of a boiler. The quantity of the fuel consumed, the quantity of the heat generated and the quantity of liquid evaporated are related to each other as shown in Fig. 3c.

(d) Interaction as in (c), but with the difference that at some points, two or more laws are acting in parallel.

An example of this type of interconnection would be the series of laws which act in a Pipe still. The fuels develop, by combustion, a determined quantity of heat which is transmitted to the oil by convection and radiation represented in the scheme by the lines k and r. The lines join in a point representing the heat content of the heated oil, which in turn is related to the degree of evaporation.

These examples represent some simple forms of natural laws acting jointly. Such forms of action may readily be found in any technological process. In fact, an ideal continuous technological process is the result of natural laws acting jointly, in which the acting forces are in a state of stationary equilibrium. Such processes may be represented by a net consisting of models of natural laws acting jointly, some of which have been given above. In Fig. 3a-d these forms are presented separately but it is obvious that by connecting them a more or less regular net results.

Supposing a net had to represent a process in a state of stationary equilibrium (Fig. 4). This net would consist of interconnected models of joint action of natural laws. Any node represents a quantity and any line connecting two nodes represents the law by which the interdependence of the quantities is related.

A technological process may therefore be represented by a net of the laws governing it. In a technological process represented by a net of laws, a change in the magnitude of a quantity represented by a node will cause changes in the other nodes.

Two cases must be considered to examine the dependence of the change in the value of the quantity U on another P, when the quantities U and P are not directly dependent on each other.

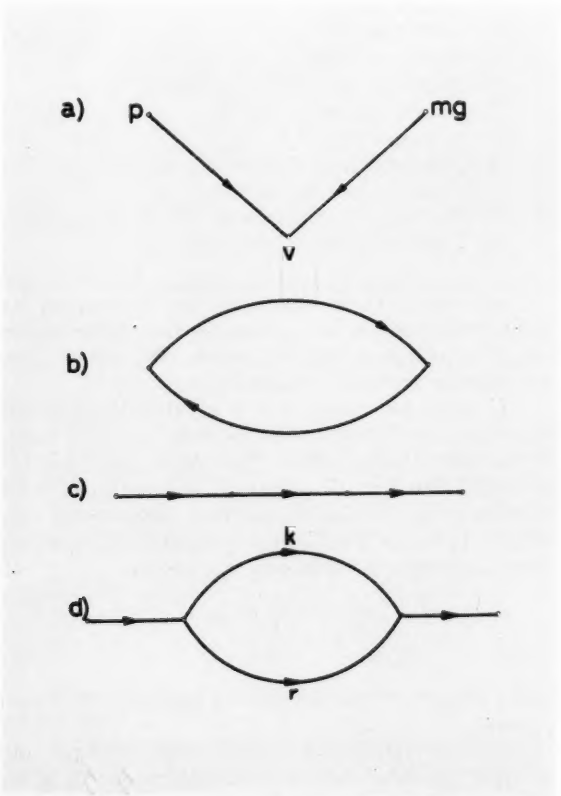


Fig. 3. Some schematically represented simple forms of joint action of laws.

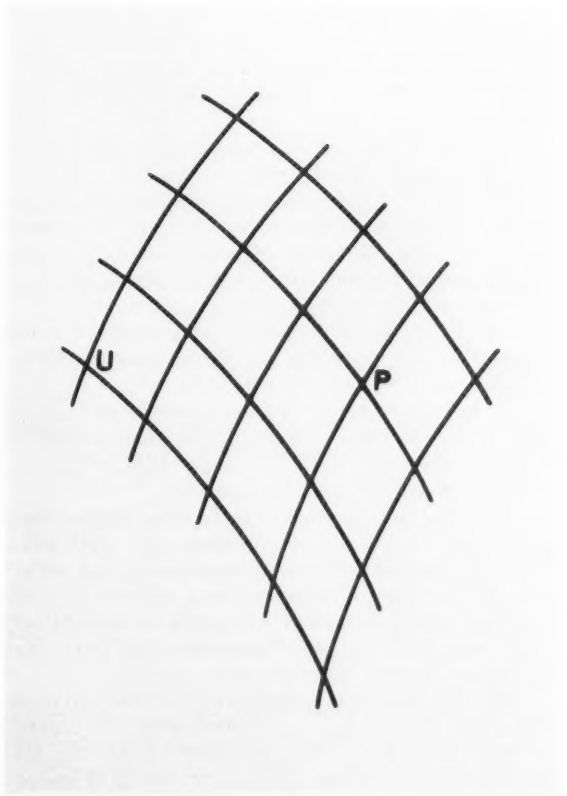


Fig. 4. A net of laws representing a technological process.

In the first case when the net of laws governing the interdependence of the quantities U and P is simple enough to be analytically resolved, we shall find a more or less intricate function encompassing all the laws relating U to P. In the second case, where no analytical solution is possible, the interdependence of P and U may only be treated by empirical methods.

In recapitation of the foregoing, we may state first that a technological process may be represented by a net of laws in which any node represents a quantity and any line a law by which the quantities are interrelated. Second, that the change in the values of the single quantities and the effect caused by those changes through the net of laws will give a picture of the mechanism of the process.

In the application of the above general principles to the internal combustion engine one is confronted by the following difficulties:

(a) Some of the characteristic qualities vary cyclically during the engine operation.

(b) The phenomena that take place in the engine are not localized, e.g. the oxidation of the lubricating oil takes place not only at the piston, but in other parts of the engine as well.

(c) In view of the fact that the engine operation is a complex process, it is not always possible to analyse all the phenomena from the standpoint of ultimate laws of physics and chemistry governing the process. These difficulties will prevent obtaining a complete picture of the engine process, but they will not hinder our getting an idea of the interrelation of the phenomena and a better understanding of the process itself.

Bearing this in mind, the following assumptions will be made in order to avoid the difficulties mentioned:

(a) For those quantities varying cyclically, the average values shall be taken.

(b) It will be supposed that the phenomena are localized in the zone where they take place predominately, e.g., the oxidation of lubricating oils is considered to occur in the piston zone although there are other points where the oxidation occurs.

(c) It will be of no concern whether the elements forming the net of action are simple laws of physics and chemistry, or more intricate laws.

It is clear from the examples concerned that the basic forms of joint action are the same regardless of their being composed of simple laws of physics and chemistry or of more complex ones.

It is desirable to use the facts given in the literature, where the correlations between the single quantities are described. These correlations are not always the simple laws of chemistry and physics, but the result of their joint action, and could be studied only in an empirical manner. These empirical laws shall be used and simply called relations.

By this term it is understood that the law represented by a line is in fact a complex law that should be represented by a net, but is omitted for the sake of simplicity or because the form of the net is ignored.

With the foregoing assumptions, a diesel engine working under constant load will be considered. After starting and warming up the working condition will gradually be stabilized so that we may consider the process to be in a state of stationary equilibrium. It is recognized that in a rigorous sense for single elements of the engine, e.g., the piston, the temperature is changing in a cyclical manner. It is understandable that the expression of stationary equilibrium denotes that the heat input into the piston will equal the output of the piston.

The phase of the process will be followed but to be able to do this, the following characteristic quantities must first be considered:

1. Fuel consumption
2. Compression ratio
3. Heat generated per unit of time
4. Maximum temperature in combustion chamber
5. Average temperature on piston skirt
6. Lubricating oil oxidation rate as expressed by per cent combined oxygen
7. Solubility of oxygen in lubricating oil
8. Deposit on piston skirt
9. Sulfur content of fuel oil
10. Quantity of sulfur entering the engine in unit time
11. Corrosive wear of cylinder liner and piston rings
12. Abrasive wear of cylinder liner and piston rings
13. Quantity of gases blown by
14. Quantity of sludge formed by the action of sulfuric acid on lubricating oil
15. Overall heat transfer coefficient from combustion products to cooling medium
16. Temperature of cooling medium
17. Cetane number of fuel oil
18. Ignition delay of fuel
19. Lubricating oil dilution expressed as per cent of fuel in lubricating oil
20. Viscosity of lubricating oil on piston skirt
21. Viscosity index of lubricating oil

On Fig. 5 these quantities are represented by points, whereas the laws governing their interrelation are given as lines uniting the points. The arrows show the direction from the cause to effect.

In order to explain Fig. 5 we shall describe the phenomena occurring in the working engine in terms of the above introduction. The combustion chamber is heated first by the polytropic compression (compression ratio ϱ) from the air inlet temperature (absolute) T_1 to the temperature (absolute) T_2. Between these temperatures the known relationship

$$\rho = \left(\frac{T_2}{T_1}\right)^{1/n-1}$$

exists where n is the exponent of the polytropic compression.

By the injection of the fuel quantity G per unit of time, the heat H_iG is generated, where H_i is the calorific value of the fuel. This heat raises the temperature of the combustion products to the temperature T_3 (at constant pressure).

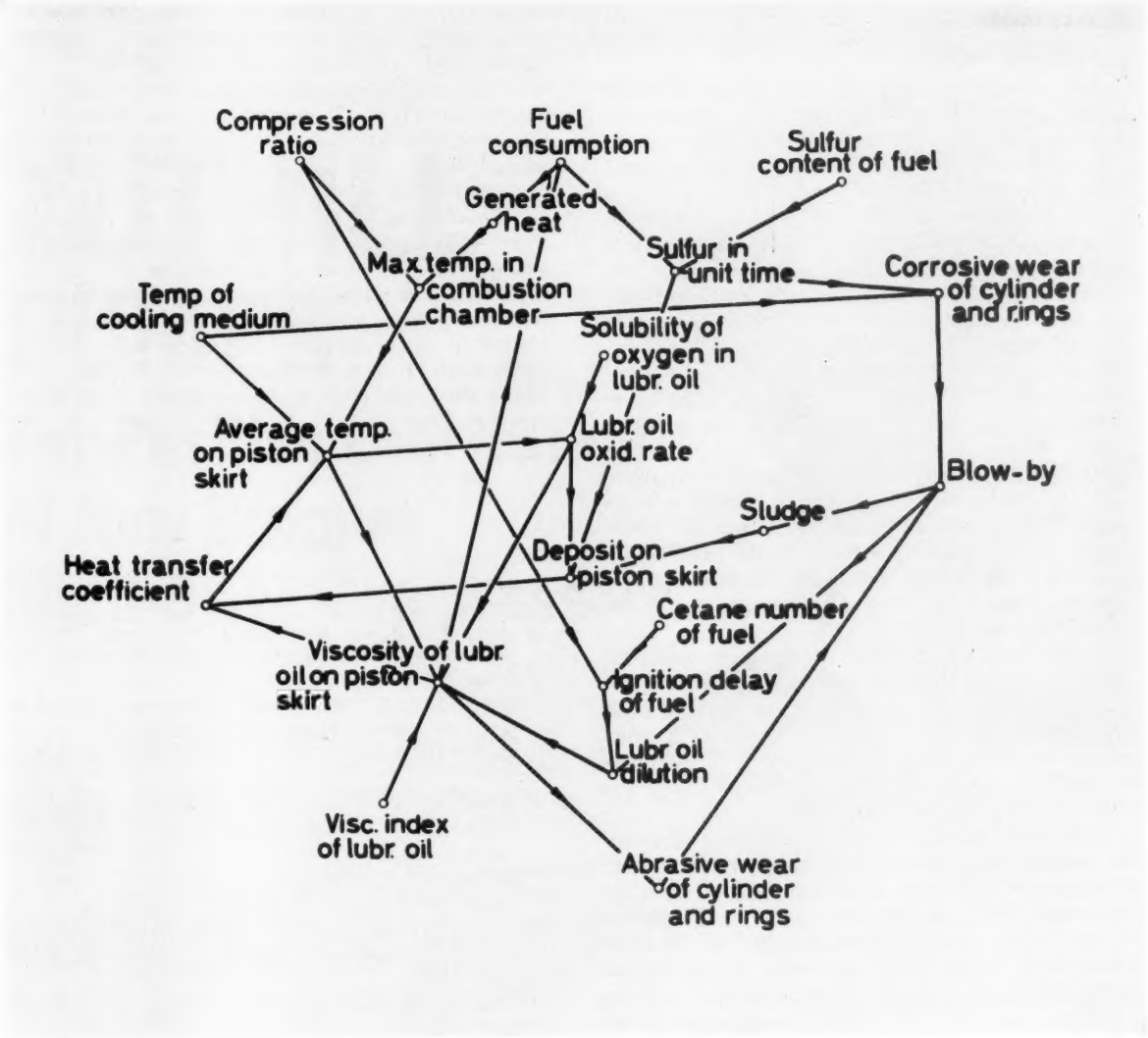


Fig. 5. Schematically represented interconnections of laws governing the compression ignition engine process.

The quantity of combustion products per unit weight of fuel is $(1 + \alpha)$ units of air (where α is the air/fuel ratio) plus α^1 residual from the preceding combustion cycle. If c_m represents the average specific heat of all the gases in the combustion chamber, we have:

$$c_m(1 + \alpha + \alpha')(T_3 - T_2) = H_i$$

This formula permits calculation the maximum temperature T_3.

As a consequence of the temperature difference between the hot combustion gases and the cooling medium two heat flow streams are established, one from the cylinder walls across the oil film that adheres to the wall and the other across the piston and cylinder walls, thereby, a temperature gradient through the following strata is established:

Hot gases
Piston head deposit
Piston
Piston skirt deposit
Oil film
Cylinder
Cooling medium

The average piston skirt temperature is very interesting, since it is there that the important lubricating oil oxidation process take place.

On account of the complexity of this phenomenon it is difficult to find the dependence of the maximum combustion chamber temperature and the piston zone temperature. The relation between these two quantities

may be found by a method analogue to the one used by Taylor and Taylor (6), which is based on dimensional analysis.

The influence of the piston skirt temperature on the lubricating oil is two fold. First, this temperature has an influence on the lubricating oil viscosity in this zone as determined by the viscosity—temperature dependence. Second, this temperature determines the oxidation rate of the lubricating oil. This reaction cannot be considered to be heterogeneous because it could not be ascertained that it took place at the boundary phase between the gas (air) and the liquid (lube oil). On the contrary, according to Bondi (7) it appears that only dissolved oxygen reacts. The solubility of the oxygen in the oil and therefore the temperature and the partial pressure of the oxygen determine the diffusion rate, and therefore the oxidation rate.

As Georgi and Taylor and Taylor (8, 9, 13) have shown the lubricating oil (and fuel) oxidation rates primarily act on the forming of deposits in the piston zone and on the viscosity increase of the oil. The deposit in the piston zone influences the heat transfer coefficient through the piston to the cylinder walls as does the lubricating oil viscosity.

Considering the influence of the fuel (and lube oil) sulfur content there are two modes of action. According to Georgi (10) one is the direct piston deposit forming tendency depending on the sulfur in the fuel the other is the forming of acid combustion products (SO_2 and SO_3), that cause the corrosive wear of the upper cylinder parts and piston rings.

The result of this wear is the blow-by of gases. The combustion gases containing SO_2 and SO_3 enter the crankcase and form sludge in contact with the lubricating oil that in turn contributes to the deposit forming tendency on the piston skirt and on the other engine parts. In addition lubricating oil dilution is due to blow-by.

Furthermore, the influence of the compression ratio on lubricating oil dilution must not be forgotten.

From the instant of fuel injection to the instant of pressure increase due to combustion there is a certain time elapse that is called the ignition delay. This delay must necessarily be very short for high speed engines. It depends in the first place on the chemical constitution of the fuel and is measured by cetane number. It depends also, for a given fuel, on the pressure and temperature at the instant of injection. These two factors, the ignition delay and the pressure are inversely related. Thus if the compression is lower, the ignition delay is increased. In other words, for increased ignition delay a larger portion of the fuel leaving the fuel atomizer system will reach the cylinder walls without burning and will dilute the lubricating oil (11).

The dilution effect like other positive and negative factors influencing the viscosity are of importance because of their effect on the internal friction of the engine.

A great part of the friction losses of the engine is derived from the piston and piston ring friction (the losses in the bearings rarely surpass 5% according to Taylor and Taylor (12)). This is due to the large contacting surfaces, to great relative velocities between the surfaces and to the fact that the lubricating conditions are rather poor at these points.

Experimental data of Wilson, Sweeney and Taylor and Taylor (4, 5, 12) confirm that the internal friction is reduced with lower viscosity of the lubricating oil and thereby the fuel consumption is reduced. This explains the line drawn between these points in Fig. 5.

Finally, the effect of viscosity on the mechanical wear will be considered. Many measurements by Georgi (14) show that it increases as the viscosity is lowered. The abrasive cylinder and piston ring wear contributes to the blow-by especially when this wear is limited to one sector according to works by Morgan Jones (15). This line connecting these quantities in Fig. 5 closes the cycle of the simplified diesel engine process scheme.

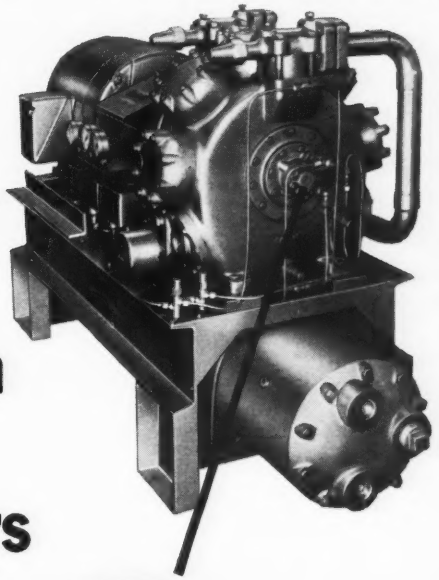
BIBLIOGRAPHY

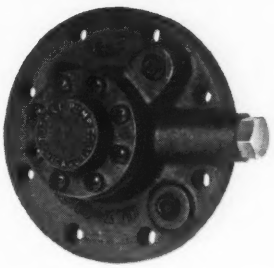
1. Vogelpohl, G., "Lubrication Problems," III. World Petr. Congr., p. 298/VII.
2. Denison, G. H., and Kavanagh, F. W., "Recent Trends in Automotive Lubricating Oil Research," IV. World Petr. Congr., p. 75/6.
3. Matthews, G. B., "How Crankcase Lubricating Oils of Internal Combustion Engines Alter During Use." Preprint paper 9/III—Conference on Lubrication and Wear. London 1957.
4. Wilson, A., "The Development of Fuels and Lubricants in Relation to Diesel Engine Requirements," IV. World Petr. Congr. p. 323/VI.
5. Sweeney, W. J., "The Effect of Fuels and Lubricants on Engine Performances," IV. World Petr. Congr., p. 381/VI.
6. Taylor, C. F. and Taylor, E. S., "The Internal Combustion Engine," International Textbook Co. (Scranton), p. 129. 1948.
7. Bondi, A., "Physical Chemistry of Lubricating oils," Reinhold Publishing Corp., p. 271, 1951.
8. Georgi, C. W., "Motor Oils and Engine Lubrication," Reinhold Publishing Corp., p. 303, 1954.
9. Ibid., p. 314.
10. Georgi, C. W., Ibid., p. 365.
11. Groff, J., "L'A. B. C. du Graissage," Revue de l'Inst. Franc. du Petr., 1951, p. 431.
12. Taylor, C. F. and Taylor, E. S., Ibid. p. 195.
13. Taylor, C. F. and Taylor, E. S., Ibid. p. 218.
14. Georgi, C. W., Ibid. p. 375.
15. Morgan Jones, C., "Diesel Operators Guide," McGraw-Hill Book Co., p. 145, 1956.

Another pump problem . . . solved by **TUTHILL**

TUTHILL PUMPS

For Positive Lubrication of New Brunner Multi-Drive Compressors





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Lubrication Abstracts

Edited by W. E. Campbell

Selected literature compiled by members of the Technical Committees and Industry Councils of the Society.

Staff Writer, "Machine Copper Coats Wire for Better Cold Heading," *Steel*, v. 145, no. 20, 1959, 116.

Superior strength and grain structure is claimed for fasteners made from copper coated stainless steel wire. Electrolytic plating unit deposits a 0.0002 in. copper coating which serves as a lubricant when stainless steel is fabricated into bolts and other fasteners. (*Abstractor: R. McKay*)

D. S. Davis (University of Alabama), "Find Blend Viscosity by Nomograph," *Petroleum Refiner* v. 38, no. 1, 1959, p. 216.

A nomograph is given for determining viscosity of oil blends in mole percentages. This chart eliminates the need for solving the Kendall and Monroe equation for binary mixtures, and like the equation, is good in most instances to within 2 percent. (*Abstractor: M. I. Smith*)

Staff Writer, "Machining Teflon to ± 0.0005." *American Machinist*, v. 103, no. 17, 1959, 107-108.

Teflon is difficult to mold due to poor flow except at very high temperatures. Three case histories are cited which indicate the following factors for machining Teflon to close tolerances: good cutting oil with stellite tools; very sharp cutting edges; 15-20° top rake on form tools for rapid removal; 10-15° front clearance to minimize compressive forces and possible distortion; turning tools should have large cutting angles; drills should have polished flutes. (*Abstractor: N. C. Morrell*)

J. J. Obrzut (Technical Editor), "Cutting Oils and Coolants," Iron Age, v. 185, no. 9, 1960, 87-102.

A general review of the functions of cutting fluids is presented under five sections, (1) What Does a Cutting Fluid Do?, (2) Matching Cutting Fluid to the Job, (3) How Metals Influence Selection, (4) Tooling: Speeds and Pressures Exert Heavy Burden, (5) Care of Cutting Fluid Pays Off. Cutting Fluids are used to remove heat from the zone of the tool tip, and to reduce friction between the sliding chip and the cutting tool. Chemically active fluids are necessary to carry out this function at the chip-tool interface, where high pressures and temperatures prevail. A variety of fluids are available. No simple set of rules exist that will determine which fluid is most suitable. Selection is influenced by the choice of cutting tool, depth of cut, type of operation, feeds, speeds, the machine, and the desired accuracy. The physical and metallurgical properties of the metal also significantly affect the choice of the cutting fluid. Optimum performance presupposes proper handling, storage and application of the cutting fluids. Helpful suggestions are given in all sections. (*Abstractor: W. J. Wojtowicz*)

Thomas C. Smith (Behr-Manning Co.), "Techniques in Flat Finishing—Application of the Lubricant," *Grinding & Polishing*, v. 5, no. 3, 1959, 22-23.

The properties and method of application of lubricant are described. For more uniform application of oil or grease to the belt surface a short-napped paint roller has replaced the former uneven smearing with a brush. Basic recommendations for consistency and type of lubricants are: (1) for coarse grits, below 120 aluminum oxide: Mineral-lard oil of 100 Saybolt Seconds at 100°F, nonstaining for non-ferrous metals, but containing sulfur and/or chlorine for ferrous jobs. (2) for finer grits, 120 to 150: slightly more viscous oil of same nature affording cushioning to prevent goughing by individual grits. (3) for grits 150 to 180: lighter oil of 70 or less Saybolt Seconds. Should even light oil prevent grain penetration to metal surface, spray application is recommended in place of roll-film coating of lubricant on stock. (4) for grits 180 to 320: low M. P., nongumming grease, non-staining on nonferrous jobs. The chief advantage of oil or grease lubrication of abrasive belts is that there is no attack on any type of grit bonding. (*Abstractor: N. C. Morrell*)

E. D. Brown, Jr. (Silicone Products Dept., General Electric Co.), "New Lubricants and Hydraulic Fluids for High Temperatures," *Materials in Design Engineering*, v. 47, no. 4, April 1958, pp. 124-6.

Three new chlorophenyl-containing methyl silicone fluids known as Versilubes are designed for −65°F to 700°F lubricant or hydraulic fluid operation. Each fluid is intended for a specific property, i.e., lubricity, thermal stability, or oxidative stability. The viscosity-temperature coefficient defined as Vis. at 100°F minus Vis. at 212°F divided by Vis. at 100°F is 0.60 for these oils. Properties are compared to other lubricants by graphs and text. (*Abstractor: George C. Lawrason*)

in'dis·pen'sa·ble
is the word to describe

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by Professor Dudley D. Fuller, Columbia University.
A research project financed by the American Society of Lubrication Engineers with the cooperation of industrial sponsors.

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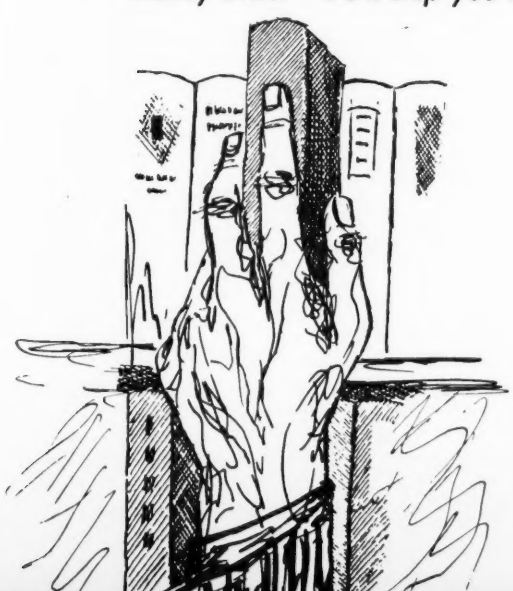

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Patent Abstracts

Compiled by Ann Burchick
Aluminum Co. of America

Method for Degasifying an Organophilic Clay-Bodied Lubricant, Patent #2,921,028 (C. A. Stratton, assignor to Phillips Petroleum Co.) In a process for manufacturing a bodied lubricant wherein an organophilic clay is colloidally dispersed in an organic lubricating liquid the improvement which comprises degasifying said clay prior to colloidally dispersing said clay in said liquid.

Extreme Pressure Lubricating Oils, Patent #2,918,433 (J. P. Buckmann, assignor to Union Oil Co. of California) An extreme pressure lubricating oil consisting of an ester lubricating oil, which ester lubricating oil is selected from the class consisting of monohydroxy aliphatic alcohol diesters of dicarboxylic acids, glycol monoalkyl ether esters of dicarboxylic acids, and polyglycol monoalkyl ether esters of dicarboxylic acids, containing between about 2% and about 15% by weight of a completely esterified polymerized glycol ester of a mixture of dicarboxylic acids obtained by oxidizing refined paraffin wax which is relatively oil-free and free from asphaltic and resinous materials, and which has a melting point between about 120 F. and about 165 F. with a gas containing free oxygen in the liquid phase at temperatures between about 210 F. and about 260 F. until the acid number of the product is between about 460 and about 600 mg. KOH/g. and separating from the oxidized paraffin wax a fraction comprising dicarboxylic acids, said glycol being a glycol selected from the class consisting of glycols containing at least 4 carbon atoms per molecule and polyglycols containing at least 3 carbon atoms per glycol unit.

Grease Manufacturing Process for Pigment or Dye Gelled Oils, Patent #2,915,470 (J. W. Armstrong and H. A. Woods, assignors to Shell Development Co.) The process for the preparation of a grease composition which comprises: (a) commingling an aqueous grease-forming dye suspension with a major proportion, based on the dye, of a hydrophobic lubricating oil; (b) passing the mixture so formed over a surface having a skin temperature between about 300 and about 350 F. in the form of a film between 0.001 and about 0.02 inch in thickness, said film being sheared on said surface by means of blades travelling at a rate of 1,000-10,000 feet per minute, the residence time of the mixture on the surface being between about 1 second and about 30 seconds during which time substantially all of the water originally present in the suspension is evaporated; (c) heating the mixture for 0.25-4 hours at 250-550 F.; and (d) thereafter subjecting the substantially anhydrous mixture to shearing action, whereby a grease structure is formed.

Pneumatic Tool Lubricant, Patent #2,918,430 (M. E. Gililland, R. C. Givens and H. D. Massin, assignors to Texaco Inc.) A pneumatic tool lubricant consisting essentially of a mineral lubricating oil having an SUS viscosity in the range of about 100 to 900 at 100 F., containing 2 to 8 weight percent of a high ester content petrolatum oxidate characterized by a Neut. No. to Sap. No. ratio below about 0.25, 0.1 to 1 weight percent sulfur dispersed in a mixture of said mineral oil and petrolatum oxidate, and 0.1 to 0.8 weight percent alkali metal sulfonate.

Mixed Base Sodium Calcium Grease Manufacture, Patent #2,915,468 (F. E. Chamberlin, assignor to Sinclair Refining Co.) In the manufacture of substantially anhydrous mixed base sodium-calcium greases wherein a mineral lubricating oil is thickened to a grease consistency with mixed sodium and calcium 12-hydroxy stearates, where the quantity of sodium employed is about 3 to 10 parts per part of calcium, and the resulting grease is dehydrated, the step of removing the water present during the final nucleation of the fibres at a temperature of at least 300 F. and insufficient to melt the fibres and at substantially constant pressure to remove water rapidly and form the fibre structure of the final composition.

Lubricating Oil Containing an Alkaline Earth Metal Sulfonate, A Co-Neutralized Nonyl Phenate, and a Metal Diamyldithiocarbamate, Patent #2,916,450 (J. R. Miller, assignor, by mesne assignments, to Esso Research and Engineering Co.) A lubricating oil composition of high stability which comprises an alkaline earth metal sulfonate selected from the group consisting of calcium and barium sulfonates in an amount within the range from about 1.0% to about 5.0% by weight, a co-neutralized sulfurized nonyl phenate in a ratio of about 2 parts of said alkaline earth metal sulfonate to about 1 part of said co-neutralized phenate, an amount of metal diamyldithiocarbamate selected from the group consisting of zinc and cadmium diamyldithiocarbamate within the range from about 0.5% to about 2.0% by weight, and the remainder a petroleum lubricating oil fraction.

(Continued on page 336)

Send for a tube and try this test! Rub some molysulfide on any piece of metal. Then force your finger across the surface and feel the high lubricity of molysulfide when your finger hits the coated spot. Molysulfide *sticks* to metal . . . does not wipe off but lubricates under high pressure.

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IN PRODUCTION

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PATENT ABSTRACTS

(*Continued from page 324*)

Method for Preparing Lithium Base Greases Involving Quenching, Patent #2,916,452 (R. C. Givens and H. J. Pitman, assignors to Texaco, Inc.) The method of preparing lubricating greases which comprises heating a mixture of a lithium soap of a hydroxy fatty acid and an oleaginous liquid in a grease forming proportion to a temperature above the solution temperature of the soap so as to form a molten homogeneous mass in a grease kettle, and then cooling the said mixture in a maintained agitated body in the grease kettle from a temperature near the solution temperature of the soap to at least 25 F. below the solution temperature of the soap at an average rate of at least about 2 F. but below about 25 F. per minute by quenching with an additional oleaginous liquid at a rate of about 0.001-0.05 gallon of oleaginous liquid per minute per pound of the said mixture and by any additional cooling employed which is obtained substantially entirely by means of cooling surfaces in contact with the said agitated body of mixture in the grease kettle.

Oxidation-Resistant Lubricating Greases Containing Inorganic Alkali Metal Compounds of High Alkalinity, Patent #2,921,899 (L. W. Sproule, J. H. Norton and W. C. Pattenden, assignors to Esso Research & Engineering Co.) A method of inhibiting a lubricating grease against oxidation wherein said lubricating grease comprises a major proportion of a lubricating oil and a minor grease thickening amount of a calcium soap thickener, which method consists of mixing into said grease an amount sufficient to inhibit oxidation of said grease of a grease inhibitor concentrate comprising about 15 to 80 wt. percent of a material selected from the group consisting of trisodium phosphate and lithium hydroxide and about 1 to 25 wt. percent of an alkali metal soap of C_{12} to C_{30} fatty acid and a dispersant proportion of a mineral lubricating oil.

Cold Forming Lubricant and Method of Applying Same, Patent #2,921,874 (W. L. Kubie, assignor, by mesne assignments, to Aluminum Research Corp.) A lubricant for use in the cold forming of selected metal billets consisting essentially of: a mixture of a lubricating agent, a reactant, and a solvent; said lubricating agent being a compound having a melting point of between 200 F and 500 F.

Process for the Manufacture of Mixed Base Sodium Calcium Greases, Patent #2,915,469 (L. D. Loring, Jr., assignor to Sinclair Refining Co.) In the manufacture of substantially anhydrous mixed base sodium calcium grease characterized by heterogeneous thin, narrow, ribbon-like fibres and larger bent, twisted fibres wherein a lubricating oil is thickened to a grease consistency with mixed sodium and calcium 12-hydroxy stearates and the resulting oil-12-hydroxy stearate mixture is dehydrated at an elevated temperature, the steps of adding water to the hot dehydrated oil-12-hydroxy stearate mixture in an amount sufficient to effect solution of fibres present and maintaining the mass at a temperature of about at least 300 F. and below the melting point of the fibres until the mass is again dehydrated while maintaining substantially constant pressure.

Petroleum Lubricants Stabilized Against Hydrocarbon Metabolizable Microorganisms, Patent #2,913,414 (E. B. Hodge, assignor to Commercial Solvents Corp.) A petroleum hydrocarbon oil of lubricating viscosity stabilized against hydrocarbon metabolizable microorganisms containing in a small but sufficient amount to inhibit bacterial growth in said petroleum lubricant.

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Grease Composition Containing Metal Salt of Reaction of Alkyl-Phenol, Fatty Acid and Aldehyde, Patent #2,921,904 (B. W. Hotten, assignor to California Research Corp.) A grease composition comprising a major proportion of an oil of lubricating viscosity and, in an amount sufficient to thicken said oil to the consistency of a grease, a metal salt of a product obtained by reacting, for a period of 1-4 hours, at temperatures ranging from 120 F. to 500 F., an alkylphenol containing from 1 to 36 carbon atoms in the alkyl radical and, for each mol of said alkylphenol, from 0.5 to 1.0 mol of a fatty acid containing from 2 to 22 carbon atoms, and from 1 to 3 mols of an aldehyde selected from the group consisting of formaldehyde and formaldehyde producing compounds.

Twister Ring Lubricant, Patent #2,922,762 (A. J. Morway, assignor to Esso Research & Engineering Co.) A twister ring lubricant composition comprising a major amount of petrolatum and 5 to 30 weight percent of hydrous mixture of metal salts of low molecular weight carboxylic acids having from about 1 to 3 carbon atoms per molecule and intermediate molecular weight carboxylic acids having from about 7 to 10 carbon atoms per molecule and wherein the molar ratio of low to intermediate molecular weight acid salts in said hydrous mixture is about 2:1 to about 40:1.

High Temperature Lubricant Composition, Patent #2,922,763 (R. B. Tierney, assignor to Texaco Inc.) A thermally stable high temperature lubricating oil composition comprising a major amount of a diester of a primary alcohol having from 4 to 30 carbon atoms and an aliphatic dicarboxylic acid having from 4 to 12 carbon atoms, from 1 to 20 percent by weight of a methacrylate polymer having a molecular weight between 5,000 and 20,000 and from 1 to 40 percent by weight of a diester of an aliphatic alcohol having from 1 to 10 carbon atoms and a dimer of ethylenic monocarboxylic acids having from 12 to 22 carbon atoms.

(*Continued on page 328*)

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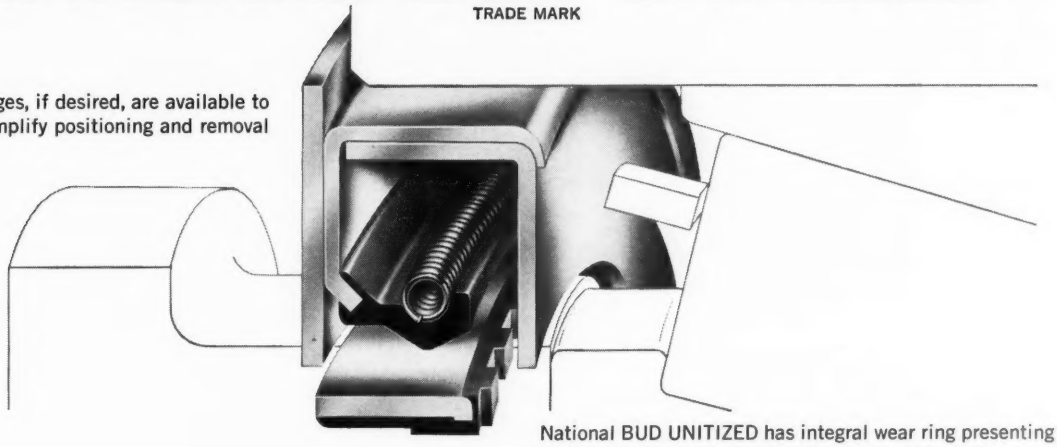
NATIONAL BUD UNITIZED

TRADE MARK

Flanges, if desired, are available to simplify positioning and removal



National BUD UNITIZED has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National BUD UNITIZED seals are now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer BUD UNITIZED seals are on the way for higher speed automotive and similar uses.

Changing a National BUD UNITIZED oil seal automatically changes the wear sleeve — in one fast, simple operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem — both thanks to the rubber surface BUD UNITIZED presents to the shaft.

For complete details or skilled engineering help on application of BUD UNITIZED seals, write direct, or call your National Seal Applications Engineer. You'll find him in the Yellow Pages, under Oil Seals.

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6013-R

PATENT ABSTRACTS

(*Continued from page 326*)

Lubricating Grease Containing an Inorganic Gelling Agent and a Polylactam, Patent #2,917,457 (D. M. Preiss, assignor to Shell Development Co.) A gelatinous composition having lubricating qualities consisting essentially of a major portion of a lubricating oil having a viscosity at 100 F. of 25 to 3500 SSU and having incorporated therein a sufficient amount of a colloidally dispersed high base exchange clay to produce a gelatinous composition of grease-like consistency, the surfaces of said clay being treated with a polymerized lactam of a monoaminomonocarboxylic acid having a chain of at least 5 carbon atoms between the carboxyl and the amino group, said polymerized lactam having a molecular weight of at least 500 and being present in an amount sufficient to impart water resistance characteristics to said composition.

Metal-Working Lubricants, Patent #2,917,459 (T. E. Reamer, assignor to Shell Development Co.) An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 1% to 25% by weight of a water-soluble heavy metal sulfamate and from about 0.01% to about 5% by weight of a water-soluble alkali metal ortho-phosphate and the balance of the solution being water.

Lubricating Composition Containing a Synergistic Extreme Pressure Additive, Patent #2,921,902 (H. J. Watson, assignor to Texaco Inc.) A lubricating composition comprising a mineral lubricating oil as the major component, 0.5 to 5.0 weight percent chlorinated paraffin wax and 0.002 to 0.1 weight percent metal dialkyl dithiocarbamate in which said metal is selected from the group consisting of zinc and cadmium and said alkyl group contains 2 to 14 carbon atoms.

Transparant Cutting Oil, Patent #2,918,432 (I-Ming Feng, assignor to Ethyl Corp.) A transparent cutting oil consisting essentially of a transparent lubricating oil and from about 0.5 to about 15 percent by weight of a monochlorophenyl dimethyl phosphorothionate.

Extreme Pressure Lubricants, Patent #2,921,903 (H. Sellei Beretvas, assignor to Standard Oil Co.) An improved extreme pressure lubricant suitable for use under hypoid gear operating pressures comprising a major amount of a mineral lubricating oil, an effective amount of lead naphthenate in the range of from about 1.5% to about 10%, an effective amount of a sulfur containing organic extreme pressure agent in the range affording from about 0.2% to about 3.0% sulfur, an amount of a chlorine-containing hydrocarbon extreme pressure agent in the range affording from about 0.3% to about 8% chlorine and from about 1% to about 10% of oleic acid.

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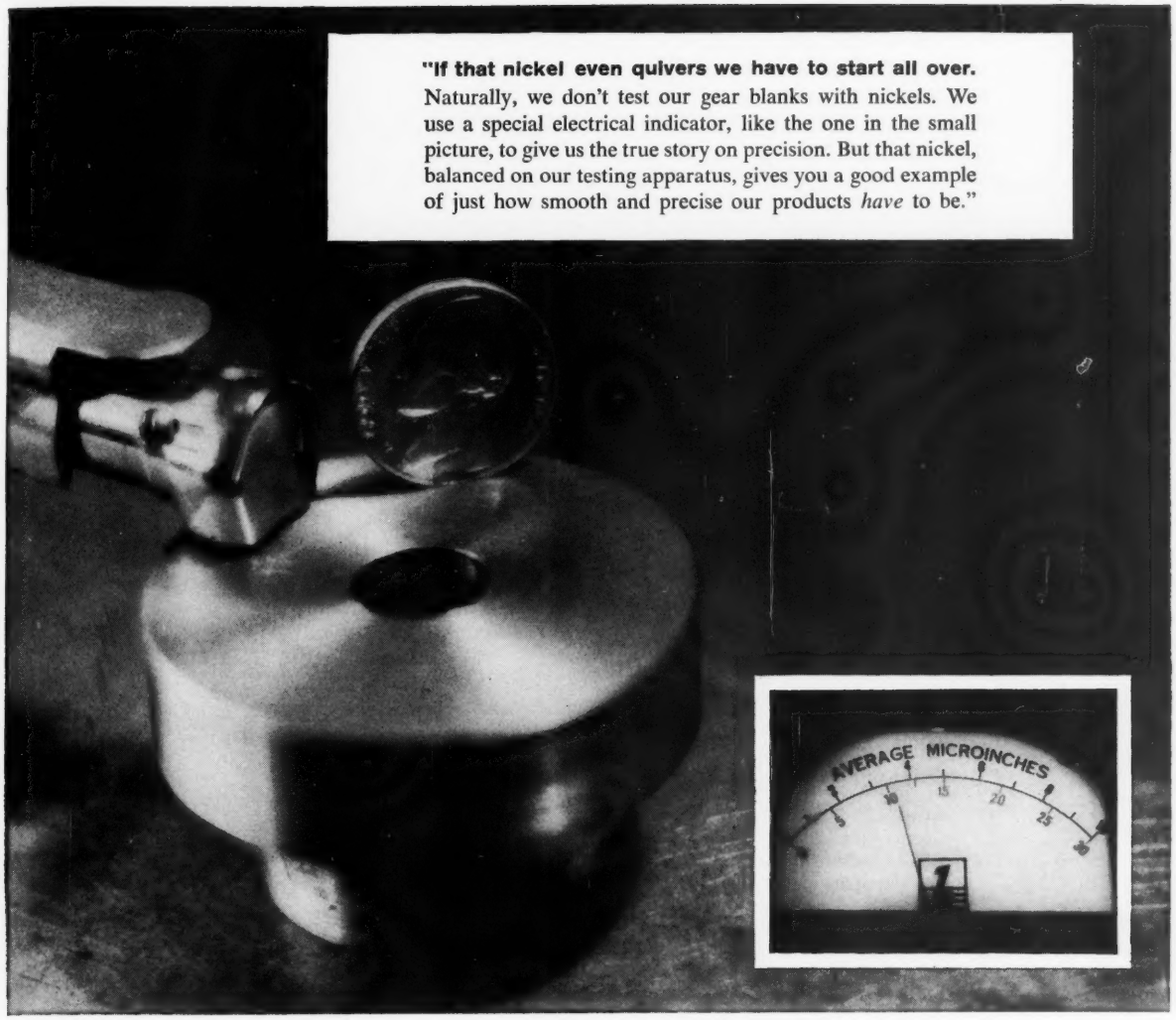
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AVERAGE MICROINCHES
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"Matter of fact," says Mr. Hoffmann, "they insisted we try other brands just to prove that Cities Service was the best for us. They proved their point. We've stuck with Cities Service."

At the present time, American Screw Machine Products Co. is using Cities Service CHILLO 10 Cutting oil, and some CHILLO 22. As Mr. Hoffmann says, "The sulphur and chlorine additives prevent welding and galling action which allows for fine finishes and long tool life that maintains high-precision, top-quality work."

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AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Statement of Cash Receipts and Disbursements
Year Ended December 31, 1959

RECEIPTS:		
Membership dues—		
Individual	$45,033.80	
Industrial	2,260.00	
Sectional sustaining	1,366.42	$48,650.22
Sale of publications		15,371.83
Exhibit funds—		
1959 show collected in 1958	4,192.50	
1959 show collected in 1959	4,987.50	9,180.00
Annual meeting—		
Guest registration and banquet tickets	6,582.28	
Lubrication engineering course	1,110.00	7,692.28
Joint Lubrication Conference		1,992.56
Advertising income		39,915.85
Gear Symposium		2,354.19
Interest and sundry income		1,827.68
Collection and exchange sundry		46.59
TOTAL		$127,031.20
DISBURSEMENTS:		
Salaries, commissions, fees	$40,192.22	
Cost of publications	34,998.54	
Office furniture and equipment purchases	559.58	
Office supplies and expense	1,815.79	
Administration travel	1,779.71	
Section payments	8,456.33	
Rent	3,768.00	
Telephone and telegraph	1,541.48	
Dues, donations and subscriptions	235.30	
Legal and auditing expense	575.00	
Federal insurance contributions and unemployment tax	809.66	
Annual meeting expense	5,475.79	
Awards expense	371.06	
Exhibit expense—1959 show:		
Paid in 1958 — 282.25		
Paid in 1959 — 1,416.83	1,699.08	
Postage and express	2,593.75	
Stationery and printing (excluding exhibit costs)	1,508.95	
Group and other insurance	723.84	
Directors' and committee meeting expense	554.67	
Contingencies	1.00	
Advertising commissions	10,149.30	
Promotional material	458.05	$118.267.10
Excess of receipts over disbursements, representing net increase in free surplus during year ending Dec. 31, 1959.		$ 8,764.10

For the year 1958 the disbursements exceeded the cash receipts by the amount of $7,569.79. This was the result of costs incurred during 1958 which were capital costs for various publications. For the year 1959 the cash receipts exceeded the disbursements in the amount of $8,764.10 which reflected income from capital costs in 1958. In combining the two years operations the cash receipts exceeded the disbursements in the amount of $1,194.31.

J. W. Peterson
Treasurer, 1959–60

American Society of Lubrication Engineers
Balance Sheet—December 31, 1959
ASSETS

Working Capital Assets:		
Cash on deposit and on hand—		
Bank checking account	$14,719.56	
Bank savings account	3,028.14	
Deposit balances in hands of others	500.00	
Petty cash fund	35.00	
Total working capital assets		$18,282.70
Reserve Fund Assets:		
Savings and Loan deposits	30,000.00	
Investments in United States Treasury Bonds—at cost	14,709.11	
Total reserve funds		44,709.11
Office Furniture and Equipment:		
At cost	12,273.41	
Less: Allowance for depreciation	5,654.89	
Net book value		6,618.52
		$69,610.33

LIABILITIES AND SURPLUS

Liabilities;		
Account payable as trustee—award fund contributed by W. D. Hodson, Jr.	50.00	
Account payable—payroll withholding taxes	545.20	
Total liabilities		595.20
Surplus:		
Surplus reserve—Unearned rentals collected during 1959 for 1960 Exhibit—net of expenses paid	3,614.50	
Free surplus	58,782.11	
Surplus invested in office furniture & equipment	6,618.52	
Total surplus		69,015.13
		$69,610.33

NOTE: The above statement has been prepared on the basis of cash receipts and disbursements.
THE ABOVE REPORT IS IN AGREEMENT WITH THE AUDITOR'S REPORT AS PREPARED BY C. L. GRIMES & CO., CERTIFIED PUBLIC ACCOUNTANTS.

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PERSONALS

(*Continued from page 297*)

The appointment of Maurice G. Jewett as engineering director of all its chain divisions has been announced by Chain Belt Company, Milwaukee. It was also announced that Kenneth P. Coan succeeds Jewett as manager of the company's chain and transmission division.

M. G. JEWETT

JOHN G. GILL

John G. Gill has been appointed Assistant Director—Process Development in Crucible Steel Company's Technology Department. In his new position Mr. Gill will supervise the planning, evaluation and coordination of all process technical development activities.

Leslie L. Walmsley and Irving H. Welch have been promoted in American Viscose Corporation's Technical Service Department. Mr. Walmsley has been promoted to the newly created position of Converting Relations technical advisor. Mr. Welch has been promoted to head of the Dyeing and Finishing Division of the Technical Service Department.

The creation of new Western and Midwestern sales divisions has been announced by Snap-Tite, Inc., Union City, Pennsylvania, producer of quick-connect valved couplings. The appointment of the following men to supervise the new districts have also been announced: Tom Welsh, Western Division; L. R. Finn, Midwestern Division; and Harold Fisher, Eastern Division.

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TRABON®

CENTRALIZED LUBRICATING SYSTEMS

1/3 of a mile of brand-new, ultra modern steel mill at U. S. Steel's Duquesne Works is equipped with Trabon automatic centralized lubricating systems.

33 "original container" barrel pumps, each with its own automatic control and central warning system, serve the components of this tremendous new facility.

Included are the Mesta 45″ slabbing mill and shear, Birdsboro 36″ blooming mill and shear, United 21″ billet mill and traveling hot saws, Morgan flying shear, Linde Descarfer, Morgan, Alliance and Cleveland cranes, ingot buggy, tables and accessory equipment. It is indeed significant that the designers of this fine new mill selected Trabon.

In buying new or rehabilitating old machinery don't overlook the importance of a good lubricating system. When you specify Trabon — you get the best!

4522 Bearings at U. S. Steel's Duquesne Works expansion protected by TRABON

The new 36″ Birdsboro Blooming Mill is served by a Trabon heavy-duty Type MX System — *completely automatic — completely positive — and providing immediate central warning* at the control panel. Reset indicators in all valves quickly pinpoint trouble when central warning is given.

"Centralized" OIL AND GREASE SYSTEMS "Meterflo" CIRCULATING OIL SYSTEMS "Meter-Mist" OIL SYSTEMS

Trabon® **Trabon Engineering Corporation** 28787 Aurora Road • Solon 39, Ohio

HODSON

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METALICGREASE NONSEPARA NOMELT

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